ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

ŞİŞECAM

www.glassconference-sisecam.com

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

ŞİŞECAM

www.glassconference-sisecam.com

PUBLISHED BY

Türkiye Şişe ve Cam Fabrikaları A.Ş.
İçmeler Mah. D-100 Karayolu Cad. No: 44A
34947 Tuzla, İstanbul, Turkey
Tel: +90 850 206 50 50

Şişecam Science, Technology and Design Center
Cumhuriyet Mah. Şişecam Yolu Sok.
No:2, Gebze, 41400, Kocaeli, Turkey

Tel: +90 850 206 04 88

www.sisecam.com

www.glassconference-sisecam.com

Notice
Corresponding authors are responsible for the accuracy of their proceedings' content as well as the name, affiliation and address information of all their coauthors.

CONTENTS

"Şişecam International Glass Conference 2019, SIGC 2019" is the result of a 33 years of uninterrupted effort to establish a platform for dissemination of recent progress in "glass science and technology" in our geography through "Şişecam Glass Symposiums" and to promote Istanbul as an attractive hub.

The SIGC 2019, on 20th-22nd November 2019 in Istanbul, is aimed at providing the scientists, researchers and engineers from all over the world a scientific forum of discussions to exchange ideas and the progress in research and technological development results of glass science, technology as well as production. We do also hope that the SIGS 2019 with the theme of "Glass in the Sustainable Future: Achieving What Is Possible..." would foster international collaborations in the sector.

From this year on, we are gratified to start this international biennial platform with an expert training day with three parallel sessions offered by leading technology companies in the glass industry before the conference. Scientific programme covers ten different main session topics over 2 days on 5 parallel sessions, with relevant keynote and invited presentations on emphasized subjects addressing key global drivers in the glass industry such as Climate Change and Digitalization. Selection of advanced technical and scientific papers will provide the attendees a broad insight on todays and future directions of glass research. Innovative glass manufacturing technologies, new functionality in glass for emerging applications, advanced glasses and functional coatings are among significant highlights.

As we embark on our ambitious journey towards exploring and hopefully achieving 'what is possible', Şişecam warmly welcomes scientists, engineers, technology providers, students and investors from universities, research institutions, suppliers and other glass manufacturers to present, discuss and share the latest developments on "Glass Science, Technology and Production " on a global scale.

We would like to express our deep appreciation and gratitude to all the plenary and the keynote speakers and researchers contributing with their research knowledge and experience to the SIGC 2019 and the last but not least to all the committee members for their devotion and competent work.

We hope that the SIGC 2019 for you will be a fruitful conference with many collaboration in the glass science, technology and production community and unforgettable experience of the uniqueness of the history of Istanbul.

Prof. Dr. Ahmet Kırman
Conference President
Vice Chairman and CEO, Şişecam

Prof. Dr. Şener OKTİK *Conference*
Executive Chair
CTO, Şişecam

COMMITTEES

INTERNATIONAL ADVISORY COMMITTEE

Reha Akçakaya *(Şişecam Group, TR)*
Klaus Bange *(MK Consulting GmbH, DE)*
Mark Bennett *(Land Instruments International Ltd., UK)*
Manoj Choudhary *(Land Instruments International Ltd., UK)*
Reinhard Conradt *(MKC Innovations & Former President of ICG, US)*
H. Volkan Demir *(Bilkent University, TR)*
Alicia Duran *(Instituto de Cerámica y Vidrio & President of ICG, ES)*
T. Burhan Ergene *(Şişecam Group, TR)*
Anne-Jans Faber *(CelSian Glass & Solar B.V., NL)*
Nicola Favaro *(Stazione Sperimentale dei Vetro, IT)*
Stuart Hakes *(FIC (UK) Limited, UK)*
Russell J. Hand *(University of Sheffield, UK)*
Hiroyuki Inoue *(Tokyo University, JP)*
Himanshu Jain *(Lehigh University, US)*
Abdullah Kılınç *(Şişecam Group,TR)*
Jaroslav Klouzek *(University of Chemistry and Technology, CZ)*
Robert Lipetz *(Glass Manufacturing Industry Council, US)*
Hasan Mandal *(The Scientific and Technological Research Council of Turkey, TR)*
Rene Meuleman *(Eurotherm by Schneider Electric, UK)*
Eric Muijsenberg *(Glass Service A.S., CZ)*
Fabiano Nicoletti *(Stevanato Group S.p.A., IT)*
Aydın Süha Önder *(Şişecam Group, RU)*
Melek Orhon *(TR)*
Peng Shou *(CTIEC, CN)*
Peter Simurka *(Executive Secretary of ICG, SK)*
Cemil Tokel *(Şişecam Group, TR)*
Raşit Turan *(METU, Middle East Technical University, TR)*
Alev Yaraman *(Former President of ICG, TR)*

INTERNATIONAL SCIENTIFIC COMMITTEE

Mustafa Ağatekin *(Anadolu University, TR)*
Bülent G. Akınoğlu *(Middle East Technical University, TR)*
Fehiman Akmaz *(Şişecam STDC, TR)*
Ahmet Erhan Aksoylu *(Bosphorus University, TR)*
Estela Alejandro *(Vidrala, S.A., ES)*
Dadal Arıburnu *(Şişecam STDC, TR)*
Neşet Arzan *(Şişecam STDC, TR)*
Walter Battaglia *(Stazione Sperimentale Del Vetro, IT)*
Tolga Benli *(Yaşar University, TR)*
Emre Bozbeyli *(Şişecam STDC, TR)*
Günter Brauer *(Fraunhofer Institute for Surface Engineering and Thin Films IST, DE)*
Gökberk Cinbiş *(Middle East Technical University, TR)*

Füsun Curaoğlu *(Eskişehir Technical University, TR)*
Miray Çelikbilek *(Yıldız Technical University, TR)*
Engin Durgun *(Bilkent University, TR)*
Caner Durucan *(Middle East Technical University, TR)*
Zeynep Eltutar *(TR)*
Osman Haluk Erdem *(Şişecam STDC, TR)*
Mehmet Ali Gülgün *(Sabancı University, TR)*
Oğuz Gülseren *(Bilkent University, TR)*
Mehmet Güneş *(Muğla Sıtkı Koçman University, TR)*
Oğuzhan Gürlü *(İstanbul Techninal University, TR)*
İlhan Hasdemir *(Mimar Sinan Fine Arts University, TR)*
Serim İlday *(Bilkent University, TR)*
Burak İzmirlioğu *(Şişecam STDC, TR)*
Aref Javaherian *(Şişecam STDC, TR)*
Julian Jones *(Imperial College London, UK)*
Ferhat Kara *(Anadolu University, TR)*
Adnan Karadağ *(Şişecam STDC, TR)*
Devrim Kaymak (İstanbul Techninal University, TR)
Levent Kılıç *(Şişecam STDC, TR)*
Seong Kim *(Pennsylvania State University, US)*
Selim Küsefoğlu *(Bosphorus University, TR)*
Hans Van Limpt *(SCR-Sibelco N.V., BE)*
Lale Önsel *(TR)*
Mustafa Oran *(Şişecam STDC, TR)*
Arca İyiel Orhan *(Şişecam STDC, TR)*
Lars Österlund *(Uppsala University, SE)*
Ali Ötken *(Şişecam STDC, TR)*
Lütfi Öveçoğlu *(İstanbul Techninal University, TR)*
Süleyman Özçelik *(Gazi University, TR)*
Anıl Özen *(Şişecam STDC, TR)*
Esra Zaim Özkan *(İstanbul Technical University, TR)*
Tamer Öztürk *(Şişecam STDC, TR)*
Mehmet Parlak *(Middle East Technical University, TR)*
Mathi Rongen *(CelSian Glass & Solar B.V., NL)*
Ali Serpenguzel *(Koç University, TR)*
Alphan Sennaroğlu *(Koç University, TR)*
Karel Spee *(SPG Prints B.V., NL)*
Bernd Szyszka *(Technical University of Berlin, DE)*
Erol Sahin *(Middle East Technical University, TR)*
James Thomason *(University of Strathclyde, UK)*
Dönüş Tuncel *(Bilkent University, TR)*
Seniz Türküz *(Şişecam STDC, TR)*
Tolga Uysal *(Şişecam STDC, TR)*
Lothar Wondraczek *(Otto Schott Institute of Materials Research, DE)*
Habib Yıldırım *(Şişecam STDC, TR)*
Fikret Yıldız *(Gebze Technical University, TR)*
Şener Yılmaz *(Şişecam STDC, TR)*

CONFERENCE EXECUTIVE COMMITTEE

Executive Chair
Şener Oktik

ORGANIZING COMMITTEE

Chair
Tunç Görüney

Atilla Çebi
Hande Sesigür
İlkay Sökmen
Atilla Ünsal

Semin Atılgan
Gülin Demirok
Gülşah Kahraman
Osman Burak Okan
Başak Renklioğlu

Seda Doğru
Kaan Gençceylan

Conference Secretary
Ebru Çelebi

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

PROGRAM AT A GLANCE

ŞİŞECAM

www.glassconference-sisecam.com

PROGRAM AT A GLANCE

THURSDAY, NOVEMBER 21, 2019

REGISTRATION	08:00 – 09:00				
OPENING	Hall: TOPKAPI A 09:00 - 09:30 Welcome / Opening Remarks 09:30 - 10:50 Plenary Session				
COFFEE BREAK	10:50 – 11:20				
PARALLEL SESSIONS	Hall: TOPKAPI A Time: 11:20 - 13:00	Hall: TOPKAPI C Time: 11:20 - 13:00	Hall: SAMATYA Time: 11:20 - 12:50	Hall: TOPKAPI B Time: 11:20 - 13:00	Hall: NİŞANTAŞI Time: 11:20 - 12:50
	Emerging Trends and Technologies in Glass Industry	Thin Film Coatings and Large Area Coating Technologies	Product Design	Energy, Environment and Sustainability “Glass in Circular Economy”	Composites, Bioglasses, Cellular and Granular Matter
LUNCH	13:00 - 14:00				
PARALLEL SESSIONS	Hall: EMİRGAN Time: 14:00-15:30	Hall: TOPKAPI C Time: 14:00-15:30	Hall: SAMATYA Time: 14:00-15:30	Hall: TOPKAPI B Time: 14:00-15:40	Hall: NİŞANTAŞI Time: 14:00-15:20
	Melting, Forming Processes and Bulk Properties	Thin Film Coatings and Large Area Coating Technologies	Surfaces- Interfaces, and Advanced Glass Processing	Energy, Environment and Sustainability “The Electrical Furnace of the Near Future”	Composites, Bioglasses, Cellular and Granular Matter
COFFEE BREAK	15:30 - 15:50				
POSTER SESSIONS	Hall: TOPKAPI FOYER Time: 15:00 - 16:00				
PARALLEL SESSIONS	Hall: EMİRGAN Time: 15:50-17:20	Hall: TOPKAPI C Time: 15:50-17:30	Hall: SAMATYA Time: 15:50-17:20	Hall: TOPKAPI B Time: 15:50-17:30	Hall: NİŞANTAŞI Time: 15:50-17:20
	Digitalization, Data Analytics and Process Monitoring	Thin Film Coatings and Large Area Coating Technology	Surfaces- Interfaces, and Advanced Glass Processing	Energy, Environment and Sustainability “2020 NOx”	Glass Chemistry and Structure
COCKTAIL	18:30 - 19:00				
GALA DINNER	19:00 - 23:00				

PROGRAM AT A GLANCE

FRIDAY, NOVEMBER 22, 2019

REGISTRATION	08:00 – 08:30			
OPENING	TOPKAPI A			
	08:30 - 09:10 Plenary: Ludovic Valette			
PARALLEL SESSIONS	Hall: TOPKAPI C Time: 09:10 - 10:40	Hall: EMİRGAN Time: 09:10 - 10:40	Hall: TOPKAPI A Time: 09:10 - 10:30	Hall: TOPKAPI B Time: 09:10 - 10:40
	Melting, Forming Processes and Bulk Properties “Refractory Challenges for Glass Melting Technology Development and Maintenance”	Emerging Trends and Technologies in Glass Industry	Energy, Environment and Sustainability	Digitalization, Data Analytics and Process Monitoring
POSTER SESSIONS	Hall: TOPKAPI FOYER Time: 10:00 - 11:00			
COFFEE BREAK	10:50 - 11:20			
PARALLEL SESSIONS	Hall: TOPKAPI C Time: 11:20 - 13:00	Hall: EMİRGAN Time: 11:20 - 12:50	Hall: TOPKAPI A Time: 11:20 - 13:00	Hall: TOPKAPI B Time: 11:20 - 13:10
	Melting, Forming Processes and Bulk Properties “30 Year Chimney Blocks”	Materials Modeling and Discovery, Process Simulation	Energy, Environment and Sustainability “The Electrical Furnace of the Near Future” and “Glass in Circular Economy”	Digitalization, Data Analytics and Process Monitoring
LUNCH	13:00 - 14:00			
PARALLEL SESSIONS	Hall: TOPKAPI C Time: 14:00 - 15:20	Hall: EMİRGAN Time: 14:00 - 15:30	Hall: TOPKAPI A Time: 14:00 - 15:40	Hall: TOPKAPI B Time: 14:00 - 15:40
	Melting, Forming Processes and Bulk Properties	Glass Chemistry and Structure	Energy, Environment and Sustainability “CO2 Reduction using Renewable Energy”	Digitalization, Data Analytics and Process Monitoring
CLOSING	Hall: TOPKAPI A 15:40-16:00 Closing Remarks			

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

SCIENTIFIC PROGRAM

ŞİŞECAM

www.glassconference-sisecam.com

SCIENTIFIC PROGRAM

THURSDAY, NOVEMBER 21, 2019

REGISTRATION	08:00 – 09:00	TOPKAPI FOYER
OPENING	HALL	TOPKAPI A
	09:00 - 09:30	Welcome / Opening Remarks **Prof. Dr. ŞENER OKTİK** CTO, Şişecam
PLENARY SESSION I	CHAIR	**ŞENER OKTİK**
	09:30 - 10:10	**Plenary: MILES BARR** (Ubiquitous Energy INC., United States) "Truly Transparent Solar for Electricity Generating Façades"
	10:10 - 10:50	**Plenary: DIPAK Q. CHOWDHURY** (Corning Technology Center, Korea) "Flexible Glass – Current Technology Status and Applications"
COFFEE BREAK	10:50 – 11:20	TOPKAPI FOYER
PARALLEL SESSION I	HALL	TOPKAPI A
	MAIN SESSION	EMERGING TRENDS AND TECHNOLOGIES IN GLASS INDUSTRY
	CHAIR	**MEHRAN ARBAB**
	11:20 - 11:50	**Invited: ÖZGE AKBULUT** (Sabanci University, Turkey) "PCE-Based Additives Enable the Formulation of Highly-Loaded, High-Performance Ceramic Inks for Extrusion Printing"
	11:50 - 12:20	**ELMIRA RYABOVA** (Advenira Enterprises, Inc., United States) "Non-Metallic Solar Heat Control Coating for Automotive and Architecture Glass"
	12:20 - 12:40	**LARS ÖSTERLUND** (Uppsala University, Sweden) "Functional Multilayer Window Coatings Enabling Synergistic Indoor Air Cleaning and Energy Efficiency"
	12:40 - 13:00	**KEREM ÇAĞATAY İÇLİ** (Middle East Technical University, Turkey) "Metal Oxide Nanoparticles as Charge Selective Layers for Fully Inorganic Perovskite Solar Cells"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT
PARALLEL SESSION II	HALL	TOPKAPI C
	MAIN SESSION	THIN FILM COATINGS AND LARGE AREA COATING TECHNOLOGIES
	CHAIR	**MUHAMMED HASAN ASLAN**
	11:20 - 11:50	**Invited: STEPHAN ULRICH** (Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany) "Development of Electrochromic Materials"
	11:50 - 12:20	**Invited: İLKNUR BAYRAK PEHLİVAN** (Uppsala University, Sweden) "Electrochromic Device Technology"
	12:20 - 12:40	**ERIK ROENNEBERG** (Sunphade AS, 2007 Kjeller, Norway) "Dynamic Photochromic Solar Control"
	12:40 - 13:00	**IGNACIO CARETTI** (Soleras Advanced Coatings, Belgium) "AC Magnetron Sputtering of Ceramic Targets for Dielectric Thin Film Deposition"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT
PARALLEL SESSION III	HALL	SAMATYA
	MAIN SESSION	PRODUCT DESIGN
	CHAIR	**CEMİL TOKEL**
	11:20 - 11:50	**Invited: MIKKO LAAKKONEN** (Studio Laakkonen, Finland) "Finnish Glass Design Heritage as an Inspiration on New Design Works"
	11:50 - 12:10	**JORMA VITKALA** (Glaston Finland OY, Finland) "Global Glass Trends"
	12:10 - 12:30	**NAZ A.G.Z. BÖREKÇİ** (Middle East Technical University, Turkey) "Strategies for Sustainability in the Design of Turkish Tea Glasses: An Educational Project in Collaboration with Industry"
	12:30 - 12:50	**SOLMAZ KARABAŞA** (Ministry of Culture and Tourism, Turkey) "Slow Industry": Traditional Glass Art and Mastery"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT

PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION Sub Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY "Glass in Circular Economy"
	CHAIR	**CELSIAN**
	11:20-11:45	**COR WITTEKOEK** (Vlakglas Recycling Nederland, Netherlands) "Collecting and Recycling of Flat Glass – A step forward to a Circular Economy"
	11:45-12:10	**ASTON FULLER** (British Glass, United Kingdom) "Glass in the Circular Economy – The Glass Industries' Role in Industrial Symbiosis"
	12:10-12:35	**CEDRIC JANSSENS** (Glass for Europe, Belgium) "Circular Economy in the European Flat Glass Sector"
	12:35-13:00	**THILO BECKER** (RWTH Aachen University, Germany) "An Overview of Glass Fibre Recycling"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT
PARALLEL SESSION V	HALL	NİŞANTAŞI
	MAIN SESSION	COMPOSITES, BIOGLASSES, CELLULAR AND GRANULAR MATTER
	CHAIR	**SELİM KÜSEFOĞLU**
	11:20-11:50	**Invited: FRANK R. JONES** (University of Sheffield, United Kingdom) "Controlling Interphases in Glass Fibre Composite Materials"
	11:50-12:10	**SERGEY LOTAREV** (Mendeleev University of Chemical Technology of Russia, Russia) "Performance Improvement and Laser-Induced Modification of Transparent Lithium Aluminosilicate Glass-Ceramics"
	12:10-12:30	**IAN CAMPBELL** (Cooksongold, United Kingdom) "Novel Additive Manufacturing Technologies for PtRh Glass Fibre Bushings"
	12:30-12:50	**GÜLİN DEMİROK** (Şişecam Group, Turkey) "Recipe Optimization to Improve Fiber Glass Production"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT

PARALLEL SESSION I	HALL	EMİRGAN
	MAIN SESSION	MELTING, FORMING PROCESSES AND BULK PROPERTIES
	CHAIR	**ALİ ERÇİN ERSUNDU**
	14:00-14:30	**Invited: PAUL A. BINGHAM** (Sheffield Hallam University, United Kingdom) "Towards More Sustainable Glass Manufacture: Balancing Economic, Energy and Environmental Factors"
	14:30-14:50	**ALEXANDER NIECKE** (RWTH Aachen University, Germany) "Endless Fibres Made from Regolith Simulants"
	14:50-15:10	**SHRIKAR CHAKRAVARTI** (Praxair, Inc. - Linde Group, United States) "Reducing Natural Gas Consumption of Glass Furnaces with Optimelt Heat Recovery Technology"
	15:10-15:30	**MATHI RONGEN** (CelSian Glass & Solar, Netherlands) "Experimental Techniques to Study Glass Making with a Decreased CO2 Footprint and Using Less Energy"
COFFEE BREAK	15:30 - 15:50	TOPKAPI FOYER
PARALLEL SESSION II	HALL	TOPKAPI C
	MAIN SESSION	THIN FILM COATINGS AND LARGE AREA COATING TECHNOLOGIES
	CHAIR	**İLKNUR BAYRAK PEHLİVAN**
	14:00-14:30	**Invited: ALEXANDR VINOGRADOV** (ITMO University, Russia) "Solution Chemistry for Glass Industry: Current Ideas and Innovations"
	14:30-14:50	**RUSLAN MUYDINOV** (Technical University Berlin, Germany) "Exploring Unconventional Ways to Improve Silver Based Low-E Coatings"
	14:50-15:10	**FULYA ELGİN** (Şişecam Group, Turkey) "Characterization of Multilayer Thin Film Coated Flat Glasses by FEG-SEM Technique"
	15:10-15:30	**ZEYNEP ASLANTÜRK** (Şişecam Group, Turkey) "Automated Design Framework for Thin Film Optical Coatings Using Material and Geometry Optimization"
COFFEE BREAK	15:30 - 15:50	TOPKAPI FOYER

PARALLEL SESSION III	HALL	SAMATYA
	MAIN SESSION	SURFACES-INTERFACES, AND ADVANCED GLASS PROCESSING
	CHAIR	**GÜLDEM KARTAL ŞİRELİ**
	14:00-14:30	**Invited: VINCENZO M. SGLAVO** (University of Trento, Italy) "Chemical Strengthening of Silicate Glass: Processing Issues and Innovations"
	14:30-14:50	**GOHAR SANI** (Friedrich Schiller University of Jena, Germany) "Effect of Chemical Toughening on the Lateral Hardness and Scratch Resistance of Sodalime Silicate and Aluminosilicate Glasses"
	14:50-15:10	**EZGİ DENİZ KAÇAR** (Şişecam Group, Turkey) "Investigation of Crack Formation in Chemically Strengthened Glass by Acoustic Emission Technique"
	15:10-15:30	**NAHİDE ÖZBEN** (Şişecam Group, Turkey) "Ultra Strong Sheet Glass through Super-Efficient Side-Selective Ion Exchange"
COFFEE BREAK	15:30 - 15:50	TOPKAPI FOYER
PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION Sub Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY "The Electrical Furnace of the Near Future"
	CHAIR	**EUROTHERM BY SCHNEIDER ELECTRIC**
	14:00-14:25	**RENÉ MEULEMAN** (Eurotherm by Schneider Electric, United Kingdom) "A Commercial and Technical Feasible Future for All-Electric Commodity Glass Manufacturing"
	14:25-14:50	**ANDY REYNOLDS** (Fives Glass, United Kingdom) "Cold-Top Vertical Melting for Large Scale Container Production"
	14:50-15:15	**WOLF KUHN** (Fives Stein, France) "Hybrid Melting Tanks with Highly Flexible Electrical Boosting Input: A New Challenge"
	15:15-15:40	**FRANCOIS DEBLOCK** (SGD Pharma, France) "All-Electric Melting: A Feedback from out of Practice"
COFFEE BREAK	15:30 - 15:50	TOPKAPI FOYER

PARALLEL SESSION V	HALL	NİŞANTAŞI
	MAIN SESSION	COMPOSITES, BIOGLASSES, CELLULAR AND GRANULAR MATTER
	CHAIR	**ÖZGE AKBULUT**
	14:00-14:30	**Invited: JAMES L. THOMASON** (University of Strathclyde, United Kingdom) "Towards a New Generation of Glass Fibre Products Based on Regenerated Fibres Thermally Recycled from End-of-Life GRP and GRP Manufacturing Waste"
	14:30-15:00	**Invited: SELİM KÜSEFOĞLU** (Boğaziçi University and Şişecam Group, Turkey) "Measurement of Interfacial Adhesion in Composites by the Single Fiber Fragmentation Method"
	15:00-15:20	**AREF CEVAHİR** (Şişecam Group, Turkey) "Evolution of Glass Fiber Products in Şişecam"
COFFEE BREAK	15:30 - 15:50	TOPKAPI FOYER
POSTER SESSION	HALL	TOPKAPI FOYER
	15:00 - 16:00	**EYLÜL DEMİR** (Aselsan, Turkey) "Investigation of Surface Roughness and Plasma Treatment Affects on Durability of Superhydrophobic Coatings"
	15:00 - 16:00	**FATİH DÖKME** (Şişecam Group, Turkey) "Investigations on the Microstructure Properties of Inconel 625 and AISI 316L Dissimilar Welded Joints"
	15:00 - 16:00	**GÖKTUĞ GÜNKAYA** (Anadolu University, Turkey) "The Usage of Color Glasses in Glass Mold Forming Technique"
	15:00 - 16:00	**PAVEL LARYIONAU** (Belarusian State Technological University, Belarus) "Glass-Ceramic Materials for Obtaining Propping Agent"
	15:00 - 16:00	**TATSIANA SALAMAKHA** (Belarusian State University, Belarus) "New Glass Ceramic Luminescent Materials for a Wide Application"
	15:00 - 16:00	**YAUHEN ULADZIMIRAVICH TRATSIAK** (Belarusian State University, Belarus) "Garnet Arnet Based Glass Ceramics for High Power Solid State Lighting"

PARALLEL SESSION I	HALL	EMİRGAN
	MAIN SESSION	DIGITALIZATION, DATA ANALYTICS AND PROCESS MONITORING
	CHAIR	**TANER BİLGİÇ**
	15:50-16:20	**Invited: ALP ÜSTÜNDAĞ** (Istanbul Technical University, Turkey) "An Industrial Analytics and Augmented Reality Platform – AR Produkt"
	16:20-16:40	**BERTRAND MERCIER** (Isra Vision AG, Germany) "Machine Vision and Automated Inspection"
	16:40-17:00	**GESINE BERGMANN** (VDMA e.V., Germany) "Standardization of Machine Interfaces"
	17:00-17:20	**LUC JARRY** (Air Liquide, France) "Connected Burner"
COCKTAIL	18:30 - 19:00	TOPKAPI FOYER
GALA DINNER	19:00 – 23:00	TOPKAPI A
PARALLEL SESSION II	HALL	TOPKAPI C
	MAIN SESSION	THIN FILM COATINGS AND LARGE AREA COATING TECHNOLOGIES
	CHAIR	**SERKAN ŞAHİN**
	15:50-16:10	**FATMA BEYZA YEDİKARDEŞ** (Şişecam Group, Turkey) "An Experimental Design of the Manipulative Sol-Gel Parameters for Mechanically Durable, Transparent and Anti-Bacterial Hybrid Coatings"
	16:10-16:30	**ALİ EMRE GÜMRÜKÇÜ** (Gazi University, Turkey) "Dielectric Layers Effects on Characteristics of Thin Silver Films Deposited on Glass by Magnetron Sputtering"
	16:30-16:50	**ZÜRBİYE ÇAPKU** (Gebze Technical University, Turkey) "Magnetic Characterization of Yttrium Iron Garnet Thin Films by Ferromagnetic Resonance Technique"
	16:50-17:10	**SEVDANUR SÜERKAN** (Şişecam Group, Turkey) "Development of Electrochemical Sensor for Determination of Bisphenol A"
COCKTAIL	18:30 - 19:00	TOPKAPI FOYER
GALA DINNER	19:00 – 23:00	TOPKAPI A

PARALLEL SESSION III	HALL	SAMATYA
	MAIN SESSION	SURFACES-INTERFACES, AND ADVANCED GLASS PROCESSING
	CHAIR	**VINCENZO M. SGLAVO**
	15:50-16:20	**Invited: GÜLDEM KARTAL ŞİRELİ** (Istanbul Technical University, Turkey) "New Green Technology for Boron Diffusion Applications into Different Substrates"
	16:20-16:40	**BENGÜ GÜLDALI** (Gebze Technical University, Turkey) "Acid and Alkali Resistance of Chemical Tempered Glasses: Influence of Contamination in Salt Bath"
	16:40-17:00	**ASLI ÇALI** (Şişecam Group, Turkey) "The Effect of Different Calcium Compounds on Bath Contamination in Chemical Strengthening Process"
	17:00-17:20	**BÜŞRA DEMİR** (Şişecam Group, Turkey) "The Effect of Bath Contamination on Chemical Strengthening via Different forms of Sodium Compounds"
COCKTAIL	18:30 - 19:00	TOPKAPI FOYER
GALA DINNER	19:00 – 23:00	TOPKAPI A
PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION Sub Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY "2020 NOx"
	CHAIR	**AMETEK LAND**
		PHILIPPE KERBOIS (AMETEK Land, France)
	15:50-16:40	**NEIL SIMPSON** (Simpson Combustion & Energy, United Kingdom) "2020 NOx Reduction Using In-Furnace Thermal Imaging"
	16:40-17:05	**BENJAMIN KÖSTER** (Hotwork International, Switzerland) "Regeneration Repair for NOx Reduction"
	17:05-17:30	**ERNESTO CATTANEO & GIORGIO MINESTRINI** (Stara Glass, Italy) "NOx Sustainability – Stara Glass Primary and Secondary Solutions and Related Experiences"
COCKTAIL	18:30 - 19:00	TOPKAPI FOYER
GALA DINNER	19:00 – 23:00	TOPKAPI A

PARALLEL SESSION V	HALL	NİŞANTAŞI
	MAIN SESSION	GLASS CHEMISTRY AND STRUCTURE
	CHAIR	**JAMES L. THOMASON**
	15:50-16:20	**Invited: NICHOLAS KIRK** (Glass Technology Services Ltd, United Kingdom) "Waste Not Want Not – Decarbonisation and Waste Utilisation"
	16:20-16:40	**MOHAMED TOUFIK SOLTANI** (Khider Biskra, Algeria) "Glasses Based on Antimony Oxide for Light Amplification"
	16:40-17:00	**BAHRİ ERDOĞAN** (Şişecam Group, Turkey) "Reducing Antimony Trioxide and Sodium Nitrate Consumption in Low Iron Figured Glass Production"
	17:00-17:20	**NAJI VAHEDIGHAREHCHOPOGH** (Yıldız Technical University, Turkey) "Investigation of White Light Generation in Rare Earth Doped Tellurite Glass Nanocomposites for Solid State Lighting"
COCKTAIL	18:30 - 19:00	TOPKAPI FOYER
GALA DINNER	19:00 – 23:00	TOPKAPI A

FRIDAY, NOVEMBER 22, 2019		
REGISTRATION	08:00 – 08:30	TOPKAPI FOYER
PLENARY SESSION	CHAIR	**ŞENER OKTİK**
	08:30-09:10	**Plenary: LUDOVIC VALETTE** (Owens-Illinois, United States) "Glass – The Material of Choice for Sustainable Packaging Solutions"
PARALLEL SESSION I	HALL	TOPKAPI C
	MAIN SESSION Sub Session	MELTING, FORMING PROCESSES AND BULK PROPERTIES "Refractory Challenges for Glass Melting Technology Development and Maintenance"
	CHAIR	**SEFPRO**
	09:10-09:35	**THIBAUT CHUFFART** (SEFPRO, France) "New Tuckstone Solution for Sustainable Glass Melting Furnace"
	09:35-10:00	**HARTMUT HEGELER** (Nikolaus Sorg GmbH, Germany) "Glass Melting Today and in the Future – the SORG HYBRID Melter Technology"
	10:00-10:25	**SHRIKAR CHAKRAVARTI** (Praxair, Linde Group, United States) "Deposition and Evaporation of Condensable Vapors in Thermochemical Regenerators: Self- Cleaning Mechanisms in the OPTIMELT system"
	10:25-10:45	**RAMASWAMI VELAYUDHAN** (Borosil Limited, India) "Revival of Frozen Throat for Electrical Opal Glass Melting Furnace"
COFFEE BREAK	10:50 – 11:20	TOPKAPI FOYER
PARALLEL SESSION II	HALL	EMİRGAN
	MAIN SESSION	EMERGING TRENDS AND TECHNOLOGIES IN GLASS INDUSTRY
	CHAIR	**SÜLEYMAN ÖZÇELİK**
	09:10-09:40	**Invited: MEHRAN ARBAB** (PPG Industries, United States) "Innovative Enterprise"
	09:40-10:00	**ALİ SERPENGÜZEL** (Koç University, Turkey) "Fiber Optics and Integrated Photonics Architectures Using Spherical Resonators and Meandering Waveguides"
	10:00-10:20	**YAKUP BAYRAM** (PaneraTech, Inc., United States) "Digitizing Furnace Risk and Reliability"
	10:20-10:40	**ÇAĞATAY SÜNER** (Şişecam Group, Turkey) "Using High Power Fiber Lasers on Processing Low Emission Heat Reflecting Thin Films"
COFFEE BREAK	10:50 – 11:20	TOPKAPI FOYER

PARALLEL SESSION III	HALL	TOPKAPI A
	MAIN SESSION	ENERGY, ENVIRONMENT AND SUSTAINABILITY
	CHAIR	**ABDULLAH KILINÇ**
	09:10-09:30	**ELLART DE WIT** (HyGear, Netherlands) "Gas Recycling and its Advantages"
	09:30-09:50	**PIOTR SKAWINSKI** (Air Products, Czech Republic) "New Oxy-Fuel Cleanfire HRx Burner – Lower NOx, Foam Reduction, Higher Fuel Efficiency"
	09:50-10:10	**KIMMO PYYKÖNEN** (TamTurbo PLC, Finland) "Large Savings Available in the Compressor Room"
	10:10-10:30	**ERGÜR SEVEN** (Şişecam Group, Turkey) "Oxygen Consumption Optimisation for Oxy-Fuel Furnaces"
COFFEE BREAK	10:50 – 11:20	TOPKAPI FOYER
PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION	DIGITALIZATION, DATA ANALYTICS AND PROCESS MONITORING
	CHAIR	**GÖKHAN KIPÇAK**
	09:10-09:40	**Invited: İBRAHİM HALATCI** (SAP Development Center, Turkey) "The Intelligent Enterprise"
	09:40-10:00	**PASCAL VAN PUTTEN** (Van Putten Instruments B.V., Netherlands) "Compressed Air in European Glass Factories"
	10:00-10:20	**GRÉGORY LECAT** (Heye International GmbH, Germany) "Heye Glass Forming and Inspection – Smart Technology at its Best"
	10:20-10:40	**HARALD ZIMMERMANN** (Deggendorf Institute for Technology, Germany) "The Usage of AI for Glass Process Optimization"
COFFEE BREAK	10:50 – 11:20	TOPKAPI FOYER

POSTER SESSION	HALL	TOPKAPI FOYER
	10:00 - 11:00	**IVAN LEVITSKII** (Belarusian State Technological University, Belarus) "Features of the Formation of Low-Melting Non-Transparent Glassy Coatings"
	10:00 - 11:00	**SERGEY VIKTOROVICH LOTAREV** (Mendeleev University of Chemical Technology of Russia, Russia) "Ultrafast Laser Inscription of Nanogratings in Multicomponent Glasses"
	10:00 - 11:00	**YURY PAULIUKEVICH** (Belarusian State Technological University, Belarus) "Technological and Physical-Chemical Properties of Basalt Fibers"
	10:00 - 11:00	**YURY PAULIUKEVICH** (Belarusian State Technological University, Belarus) "Influence of Silicon-Organic Compounds on the Crystallization Ability of Fused Silica Glasses Obtained by a Gas-Flame Method for Use in the Production of Refractories"
	10:00 - 11:00	**HANNA SHYMANSKAYA** (Belarusian State Technological University, Belarus) "Metallic Glazes for Porcelain Floor Tiles"
	10:00 - 11:00	**SADIK ÜNAL** (Şişecam Group, Turkey) "The Transformation of Power Generation from Gear System to the Hydraulic System at Rotary Kiln"
PARALLEL SESSION I	HALL	TOPKAPI C
	MAIN SESSION Sub Session	MELTING, FORMING PROCESSES AND BULK PROPERTIES "30 Year Chimney Blocks"
	CHAIR	**RHI MAGNESITA**
	11:20-11:45	**THOMAS ROUY-BELTRAN** (RHI Magnesita, Germany) "From Idea to Patent"
	11:45-12:10	**RONGXING BEI** (RHI Magnesita, Germany) "Development of Chemical Composition for Chimney Blocks"
	12:10-12:35	**SANDRA FISCHER** (RHI Magnesita, Germany) "Development of Shapes for Chimney Blocks"
	12:35-13:00	**RONGXING BEI** (RHI Magnesita, Germany) "Post Mortem Study of Chimney Blocks"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT

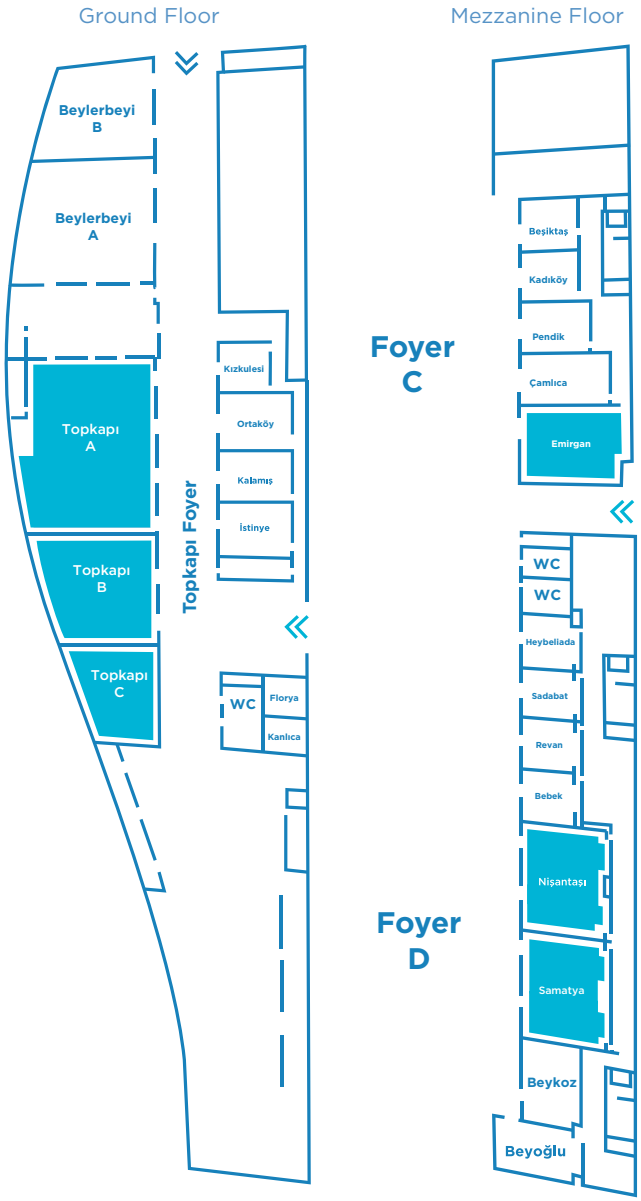
PARALLEL SESSION II	HALL	EMİRGAN
	MAIN SESSION	MATERIALS MODELING AND DISCOVERY, PROCESS SIMULATION
	CHAIR	**ALTUĞ MELİK BAŞOL**
	11:20-11:50	**Invited: ANDREAS PFLUG** (Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany) "Multiscale Modeling of Sputter Deposition onto 3D Substrates"
	11:50-12:10	**BURÇİN GÜL** (Şişecam Group, Turkey) "Improving Furnace Performance by Design and Operation"
	12:10-12:30	**NADİYE GÜR HIZ** (Şişecam Group, Turkey) "Improving the Quality of Basic Chromium Sulphate by Lean Six Sigma- Dmaic Approach"
	12:30-12:50	**SEDA YILMAZ** (Şişecam Group, Turkey) "Increasing the Conversion Efficiency of Chromite to Sodium Monochromate"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT
PARALLEL SESSION III	HALL	TOPKAPI A
	MAIN SESSION Sub Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY "The Electrical Furnace of the Near Future" and " Glass in Circular Economy"
	CHAIR	**EUROTHERM BY SCHNEIDER ELECTRIC & CELSIAN**
	11:20-11:45	**JAN KEMPERS** (Heineken Nederland, Netherlands) "Sustainable Packaging Materials Are an Essential Pillar to Support our Business"
	11:45-12:10	**GARY CAFÉ** (Schneider Electric, France) "The Energy Source of the Future from an Energy Market Perspective"
	12:10-12:35	**MUSTAFA ÜRGEN** (Egeçev Waste Management, Turkey) "Furnace Ready Cullet – Quality Achievements and Challenges"
	12:35-13:00	**BÜŞRA DEMİRCİ** (Şişecam Group, Turkey) "In the Center of Circle: Glass Is Glass Again"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT

PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION	DIGITALIZATION, DATA ANALYTICS AND PROCESS MONITORING
	CHAIR	**İBRAHİM HALATCI**
	11:20-11:50	**Invited: CENGIZ ULTAV** (VESTEL Ventures & TTGV, Technology Development Foundation, Turkey) "Major Chord"
	11:50-12:10	**PAUL SCHREUDERS** (XPAR Vision B.V., Netherlands) "A New World of Glass Making"
	12:10-12:30	**TORSTEN ULLRICH** (Zippe Industrieanlagen GmbH, Germany) "Modern Automation Systems in Batch Plants and Cullet Recycling Plants"
	12:30-12:50	**SEBASTIAN LHOTKA** (COPA-DATA, Austria) "Paperless Digital Factory"
	12:50-13:10	**ERSİN YILDIZ** (Özyeğin University, Turkey) "Numerical Study of a Continuous Annealing Furnace: Towards Simulation Based Digital Twin of the Annealing Furnace"
LUNCH	13:00 - 14:00	ÇEŞNİ RESTAURANT
PARALLEL SESSION I	HALL	TOPKAPI C
	MAIN SESSION	MELTING, FORMING PROCESSES AND BULK PROPERTIES
	CHAIR	**VEDAT SEDİROĞLU**
	14:00-14:20	**SEFA TEMİZ** (Şişecam Group, Italy) "Production of Highly Transparent Float Glass with Mid-Iron Content for the European Market"
	14:20-14:40	**SAMET BORA** (Şişecam Group, Turkey) "Ring Mechanism of Centrifugal Mold"
	14:40-15:00	**TAHİR ONUR BAKIR** (Şişecam Group, Turkey) "Inline Boring Process"
	15:00-15:20	**SAMET GÜNDÜZ** (Şişecam Group, Turkey) "Polymer Material Use in Glassware Production Process (Hot End)"
CLOSING	HALL	TOPKAPI A
	15:40-16:00	Closing Remarks Prof. Dr. ŞENER OKTİK, CTO, Şişecam

PARALLEL SESSION II	HALL	EMİRGAN
	MAIN SESSION	GLASS CHEMISTRY AND STRUCTURE
	CHAIR	**EBRU MENŞUR ALKOY**
	14:00-14:30	**Invited: EKATERINA TRUSOVA** (Belarusian State Technological University, Belarus) "Silicates Glasses Activated RRE-Ions as a Promising Material for Luminescence Applications"
	14:30-14:50	**SEÇİL AYDIN** (Gizem Frit Research and Development Center, Turkey) "Development and Characterisation of Micronized Frit to Achieve Glass-Ceramic Enamels Derived from the Li2O-Na2O-Al2O3-TiO2-SiO2 System"
	14:50-15:10	**DENİZ KOÇYİĞİT** (Aydın Adnan Menderes University, Turkey) "Dysprosium and Silver Nanoparticles Doped Borate Glasses"
	15:10-15:30	**IRYNA SULYM** (Chuiko Institute of Surface Chemistry of NAS, Ukraine) "Fabrication, Structure and Luminescent Study of Rare-Earth-Co-Doped Sol-Gel Silica Glasses"
CLOSING	HALL	TOPKAPI A
	15:40-16:00	Closing Remarks Prof. Dr. ŞENER OKTİK, CTO, Şişecam
PARALLEL SESSION III	HALL	TOPKAPI A
	MAIN SESSION Sub Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY "CO2 Reduction using Renewable Energy"
	CHAIR	**GLASS SERVICE**
	14:00-14:40	**ERIK MUIJSENBERG** (Glass Service, Czech Republic) "Options for Step Wise CO2 Emissions Reduction"
	14:40-15:10	**ERIK MUIJSENBERG** (Glass Service, Czech Republic) "Model Predictive Control and Monitoring of the Batch Coverage and Shape with NIR Camera"
	15:10-15:40	**CHRISTOPH JATZWAUK** (F.I.C. Germany GmbH, Germany) "Large Electric Furnaces & Superboosting – Is This the Future for CO2 Reduction?"
CLOSING	HALL	TOPKAPI A
	15:40-16:00	Closing Remarks Prof. Dr. ŞENER OKTİK, CTO, Şişecam

PARALLEL SESSION IV	HALL	TOPKAPI B
	MAIN SESSION	DIGITALIZATION, DATA ANALYTICS AND PROCESS MONITORING
	CHAIR	**DEVRİM KAYMAK**
	14:00-14:20	**ERÇİN TEMEL** (Proente A.Ş., Turkey) "Factory Digitalization Concept with Particular Customer Cases"
	14:20-14:40	**MURAT GENÇER** (Şişecam Group, Turkey) "Commodity Risk Management in the Glass Sector"
	14:40-15:00	**ADNAN VEYSEL ERTEMEL** (Istanbul Commerce University, Turkey) "3D Printing as a New Dimension to Marketing"
	15:00-15:20	**LEVENT KILIÇ** (Şişecam Group, Turkey) "Statistical Analysis of Power Quality Events in the Connection Point of Industrial Plants: An Outlook to Power Quality Intensity of Turkish Grid System"
	15:20-15:40	**VOLKAN TÜRKOĞLU** (Şişecam Group, Turkey) "Improved Defect Marker Detection on Flat Glass Panes through a Dual Camera Image Acquisition System on the Off-Line Cutting Line"
CLOSING	HALL	TOPKAPI A
	15:40-16:00	Closing Remarks Prof. Dr. ŞENER OKTİK, CTO, Şişecam

LOCATION OF ACTIVITIES



ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

PLENARY SPEAKERS

ŞİŞECAM

www.glassconference-sisecam.com

MILES BARR
Chief Technology Officer,
Ubiquitous Energy INC., United States

SESSION PLENARY

Date	NOVEMBER 21, 2019, THURSDAY
Time	09:30 – 10:10
Hall	TOPKAPI A
Chair	ŞENER OKTİK

TRULY TRANSPARENT SOLAR FOR ELECTRICITY GENERATING FAÇADES

Biography

Miles Barr, PhD is co-founder and Chief Technology Officer of Ubiquitous Energy. Barr previously served as the company's first CEO, securing several rounds of funding and growth through initial pilot production. For his innovations in the solar industry over the past decade, Barr has been named an MIT Technology Review Innovator Under 35, Forbes 30 under 30 in Energy, and winner of the prestigious Lemelson-MIT Student Prize. Barr holds a PhD from MIT in Chemical Engineering and a bachelor's degree from Vanderbilt University.

Abstract

Building-integrated photovoltaic (BIPV) technologies are a promising pathway to capturing large areas of solar energy and increasing building efficiency at the point of utilization. However, the widespread adoption of such technologies is severely hampered by the cost and aesthetics associated with mounting traditional PV cells on façade materials such as windows. We address this problem with the development of a transformative visibly transparent photovoltaic window coating, which allows for seamless integration of combined energy harvesting and solar control into the built environment. The truly transparent solar coating selectively converts incident ultraviolet and infrared light into electricity and simultaneously blocks transmission of unwanted solar heat, all while selectively transmitting visible light. We address the practical performance targets for such coatings and demonstrate simultaneous optimization of (1) power conversion efficiency, (2) visible light transmission, (3) solar heat gain coefficient, (4) emissivity, and (5) color. We conclude by demonstrating integration into insulated glass units (IGUs) and fabrication into prototype façades.

Keywords: *photovoltaic, BIPV, solar energy*

DIPAK Q. CHOWDHURY
Division VP and Technology Executive,
Corning Technology Center Korea, Korea

SESSION PLENARY

Date	NOVEMBER 21, 2019, THURSDAY
Time	10:10 – 10:50
Hall	TOPKAPI A
Chair	ŞENER OKTİK

FLEXIBLE GLASS – CURRENT TECHNOLOGY STATUS AND APPLICATIONS

Biography

Dr. Dipak Chowdhury joined Corning in August 1993 as a research scientist in the Mathematical Modeling group in Science & Technology. Starting as a research scientist, he built Corning's corporate Modeling & Simulation group and appointed as Research Director of the Modeling & Simulation group in 2002. In 2007, he was appointed the director of Corning European Technology Center (CETC) in Fontainebleau, France. In 2008, he was also appointed as the president Corning S.A.S., Corning's European entity. He was appointed division vice president in 2010 and joined Corning Glass Technology group as the Flexible Glass program director. In 2019 he was appointed Division VP and Technology Executive, Corning Technology Center Korea and moved to South Korea. Dr. Chowdhury holds a PhD in Electrical Engineering from Clarkson University, Potsdam, NY, and he is a fellow of the Optical Society of America.

Abstract

Precision glass has some unique attributes which enabled many applications where glass is used as a substrate or superstrate materials. Display and Photo Voltaic (PV) devices are two obvious application of rigid flat glass where both of these applications are demonstrated. Flexible substrate and superstrate is the next generation technology that is driving the new application opportunities, such as, flexible display and PV. While polymer films are the obvious choice for flexible substrate or superstrate because of ease of low cost manufacturing through roll-to-roll (R2R) processing, thermo-mechanical stability and hermiticity remains as key challenges to overcome. Flexible glass, like Corning(R) Willow(R) Glass, overcomes these challenges while enables low cost R2R processing. This presentation will summarize current state of the flexible glass technology and discuss some of the latest applications of flexible glass as substrate and superstrate.

Keywords: *photovoltaic devices, flexible display, roll-to-roll (r2r) processing, thermo-mechanical stability*

LUDOVIC VALETTE
President, Global Technology
O-I Global Headquarters, United States

SESSION PLENARY

Date	NOVEMBER 22, 2019, FRIDAY
Time	08:30 – 09:10
Hall	TOPKAPI A
Chair	ŞENER OKTİK

GLASS – THE MATERIAL OF CHOICE FOR SUSTAINABLE PACKAGING SOLUTIONS

Biography

Ludovic Valette is the Vice President, Global Technology at Owens-Illinois (O-I). He is located at the company worldwide headquarters in Perrysburg, OH. In this role, he is responsible for leading the Global Engineering organization and the exploration, R&D, optimization, deployment, and obsolescence management of technologies across O-I's global footprint. He also owns O-I's end-to-end integrated technology roadmap, oversees O-I's capital projects portfolio, and is in charge of optimizing the value of O-I's technology and intellectual property portfolio, including technology licensing and strategic relationship opportunities.

Valette joined O-I in 2013 from The Dow Chemical Company, where he spent over 13 years and held various global leadership positions in Germany, China, and the United States. He holds a master's degree in material sciences and engineering, and a Ph.D. in macromolecular chemistry and composites from the National Institute of Applied Sciences in Lyon, France. He is a certified Six Sigma green belt project leader. He recently completed several executive education programs at Stanford, Columbia, the University of Chicago, and IMD Lausanne. He is a member of the advisory board of Glass Futures (UK) and FEVE (the European Glass Container Association). He has authored or co-authored more than 20 publications in peer-reviewed journals and holds more than 25 granted patents and patent applications.

Abstract

The food and beverage industry shows a significant renewed interest for glass packaging which is growing again after years of decline. Key influencers, especially consumers and brand owners, shape strong market trends where sustainability, greater awareness of environmentally-friendly packaging, and health and wellness concerns play a primary role in the decision-making process. These driving forces combined with the fast market evolution requires glassmakers to reconsider their conventional glass packaging offering. An adequate balance between incremental improvement and radical innovation must be developed. The traditional continuous improvement process, focused on issues with strong operational relevance such as higher productivity efficiency and incremental cost optimization, must be complemented by disruptive technologies and a more radical cultural change in the glass containers industry.

For example, the emerging market need for sustainable packaging solutions should be addressed (i) by demonstrating that glass containers are the preferred choice for cradle-to-grave waste management and (ii) by developing and improving furnace design with high energy efficiency and low emissions. The development of more standardized and modular assets with lower capital intensity and greater operational flexibility would also enable glass to be better positioned with respect to alternative substrates such as PET or aluminum.

Coauthors

Jim Nordmeyer, Vice President, Global Sustainability at Owens-Illinois (O-I), USA

Keywords: *glass packaging; sustainability; innovation; cradle-to-grave waste management; manufacturing process*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

INVITED SPEAKERS

ŞİŞECAM

www.glassconference-sisecam.com

ÖZGE AKBULUT

Faculty of Engineering and Natural Sciences, Sabanci University, Turkey

Dr. Akbulut is an Associate Professor at Sabancı University, Istanbul. She received her B.S. in Materials Science and Engineering at Sabancı University (2004). Her PhD from MIT focused on cost-effective fabrication of biomolecular devices and surface science (2009). She continued her studies as a post-doctoral fellow at Harvard University on developing tools for resource-limited settings (2009–2012). Dr. Akbulut's main research interests are silicone-based composites and rheology modifiers for cement and 3D printing industry. Her spinoff, Surgitate (2014), designs and fabricates of tactile surgical training platforms.

MEHRAN ARBAB

Global Director, R&T Aerospace Coatings & Sealants PPG Industries, Inc., United States

Mehran joined PPG in 1989 after a postdoctoral appointment at Case Western Reserve University. He worked on developing architectural and automotive glass products and managed technical groups in glass and aircraft transparencies before his appointment to Director, Glass Science & Technology in 2007 and to Global Director, Research & Technology, Aerospace Coatings & Sealants in 2015.

Mehran is a two-time recipient of the PPG President's Award for Technical Achievement and an elected member of the PPG Collegium. His published work includes 20 original research or review journal articles, and he holds 42 issued US patents.

He earned a B.S. in nuclear engineering and M.S. and Ph.D. degrees in materials engineering from Rensselaer.

PAUL A. BINGHAM

Materials and Engineering Research Institute, Sheffield Hallam University, United Kingdom

Professor Paul A. Bingham gained a BEng (Hons) degree in Materials Science and Engineering from the University of Sheffield in 1995. He then pursued PhD studies, also at the University of Sheffield, on the topic of glass science and technology, and was awarded his PhD in 2000. In 1999 Paul joined Glass Technology Services Ltd as a Glass Technologist, and was promoted to Senior Glass Technologist in 2002. In this role Paul carried out industrially-focused R&D and problem-solving, ranging from development of new environmentally-friendly glasses to forensic examination and glass plant production problems. In 2004 Paul returned to academia, joining the Immobilisation Science Laboratory (ISL) at the University of Sheffield as a Postdoctoral Research Associate. In this role Paul worked on glasses and ceramics for the safe immobilisation of radioactive and toxic wastes, and also on energy-friendly materials development and waste management. Paul joined Sheffield Hallam University in January 2012 as a Senior Lecturer in Materials Engineering, and became a Reader in Materials Engineering in 2015 and Professor of Glasses and Ceramics in 2018. He contributes to teaching of Materials Engineering, with specific focus on materials composition / structure / property relations; and ceramic and glass technology.

To date Paul has published over 90 research papers in the fields of glasses; glass-ceramics; energy and the environment; waste management and nuclear and toxic waste treatment; advanced spectroscopy; and manufacturing technologies. He has co-edited and co-authored a book on the subject of low-energy, environmentally-friendly glass manufacture and he has a strong track record in attracting research funding from bodies as diverse as UK Research Councils, Innovate UK, BEIS, European Union, US Department of Energy and industry. He currently holds a number of active research grants. He is Director of Studies for several PhD students and line manages many postdoctoral researchers, visiting academics

and interns. Paul is a Fellow of the Society of Glass Technology and sits on its Basic Science and Technology Committee. He is a Fellow of the Higher Education Academy and is also a member of the Institute of Physics and the Association for the History of Glass. He is a reviewer for over 10 international journals, the US DoE Nuclear Energy Universities Programme and EU H2020 funding bids. Paul sits on several international and national committees. He is a member of the International Commission on Glass Technical Committee 5: Waste Vitrification and the RAL-ISIS Neutron User Committee. He was elected onto the Sector Decarbonisation Roadmap Committee for the ceramics industry, which directly advises the UK Government in this area. He is also a lead Academic Advisor to Glass Futures, which aims to develop a state-of-the-art training and R&D facility in glass. Paul also carries out a wide range of consultancy activities. He has consulted for the UK Government's Committee on Climate Change and for the ceramics, optoelectronics and glass industries. He also acts as an international expert witness and has worked with some of the world's largest and most well-known companies in his field. He has organised multiple conferences and was Chair of the Local Organising Committee for the highly successful Centenary Conference of the Society of Glass Technology in 2016. He has given many Invited Presentations at international conferences, and actively engages with the international academic and industrial communities.

İBRAHİM HALATCI

Development Manager,
SAP Development Center, Turkey

Mr. Halatcı is Head of Software Development for SAP Turkey. He received his B.S. in Mechatronics Engineering at Sabanci University (2004). His M.S from Massachusetts Institute of Technology focused on space robotics (2006). He, then joined The Mathworks Inc. as a Software Developer working on simulation of dynamic systems followed by AVL as lead System Engineer for electrical vehicles. He is with SAP Turkey since 2013 as part of Technology & Innovation Big Data group.

FRANK R. JONES

Emeritus Professor, Department of Materials Science and Engineering,
University of Sheffield, United Kingdom

Professor Frank R Jones began his career at Scott-Bader & Co Ltd, a pioneer and major innovator in Glass fibre Reinforced Plastics, attending part-time courses and eventually achieving the Associateship of the Plastics Institute (now Institute of Materials Minerals and Mining). After a PhD in Cationic Polymerisation at Keele University and Post Doctoral research in Mainz and York, he joined Surrey University and established research programmes to understand the environmental performance of Composite Materials. He joined the Department of Ceramics, Glasses and Polymers (now Materials Science and Engineering), University of Sheffield, in 1985, to set up Composites and Surface Analysis Laboratories, which specialised in interdisciplinary research linking environmental and interfacial performance to the mechanics of composite materials. Becoming Professor in 1993. Most recent research has developed Smart Self Healing Composites. He has been Emeritus Professor since 2009. He has published over 350 papers in journals and books and edited several texts. He was Scala Lecturer at ICCM 17 in 2009 and is a World Fellow of the International Committee on Composite Materials (2007). A textbook entitled Composites Science Technology and Engineering is in the process of publication.

NICHOLAS KIRK

Technical Director,
Glass Technology Services Ltd, United Kingdom

Nick has been at GTS for over 15 years, the organisation which provides technical support to glass sector and the supply chain. He now provides technical leadership and consultation within organisation and to the wider glass supply chain including, energy efficiency, recycling, raw material utilisation, product innovation, process improvements, product verification and as a legal technical expert.

Nick has been involved in glass sector since his PhD on glass surface chemistry in the early '90s. He represents the interest of the glass sector nationally and internationally as well as fostering the innovation and collaboration to secure a sustainable future for glass.

Nick is active on the 2050 decarbonisation action plan working with the UK Government and stakeholders to develop the opportunities and technology to reduce the CO2 impact from the glass manufacturing process. He also works on recycling legislation and policy, food contact material legislation, packaging and flat glass standards to name a few.

He is a fellow of the Institute of Materials, Minerals and Mining (FIMMM), Chartered Engineer (CEng) and Chartered Environmentalist (CEnv), with over 25 years' experience in the glass industry including being a project manager at TECO and an environmental glass consultant before joining GTS in 2003.

SELİM KÜSEFOĞLU

Department of Chemistry,
Boğaziçi University, Turkey

After obtaining his PhD at the University of Michigan in 1976 Selim Küsefoglu joined the faculty of Boğaziçi University, department of Chemistry. He served in this position for 40 years (10 as chairman) an became an emeritus professor in 2016. His field of interest is polymer synthesis and fiber reinforced composites. He has been consulting for Şişecam Elyaf A.Ş. for 29 years. During his career he has produced numerous scientific papers and patents.

MIKKO LAAKKONEN

Designer, Studio Laakkonen, Finland

Mikko Laakkonen was born in Espoo in 1974. After graduating as a musical instrument maker, he studied furniture design at Kymenlaakso University of Applied Sciences, and later received his Masters degree from the University of Art and Design in Helsinki. After working in design and architecture firms for several years, Mikko founded Studio Mikko Laakkonen in 2004.

The Studio offers product design services, with the main focus on everyday items. Mikko's designs have been on display in several exhibitions around Europe, the United States, China and Japan.

He has been awarded the number of international and national prizes, including: German Design Award (2017), Turkey Design Award (2016), Reddot design award honourable mention (2016), Chicago Athenaeum's Good Design Award (2016, 2015 & 2010), Muuuz International Awards 2014, Finnish Designer Awards '14: Furniture Designer Of The Year, Reddot: best of the best design award (2013) Reddot design award (2012), and the Young Designer of the Year prize (2009).

In 2016 Studio Laakkonen has expanded working in the fields of interior design and art direction consulting. This extension was founded to create more holistic solutions and respond better for clients requests.

Today, Studio Laakkonen works with a variety of brands and clients from all around the world.

İLKNUR BAYRAK PEHLİVAN

Department of Engineering Sciences,
Uppsala University, Sweden

Dr. Bayrak Pehlivan is researcher at the Department of Engineering Sciences, Uppsala University (Sweden). She received her BSc in Physics at İstanbul University (2002). Her MSc study was on dielectric spectroscopy of free radical polymerization of polyvinylpyrrolidone, conducted at Physics Engineering, İstanbul Technical University (2005). She graduated with the PhD degree from Uppsala University in Engineering Science. Her thesis was a study of the functionalization of polymer electrolytes for electrochromic windows (2013). She was awarded the Ångström Materials Academy Innovation Prize on the basis of a part of her PhD study on electrochromic devices with nanoparticle added-polymer electrolytes. Previously, she worked as development engineer at ChromoGenics AB, which offers dynamic glass with controllable heat- and light transmission in Sweden (2013-2015). Since the end of her parental leave (2016), she continues her research on solar water splitting systems, including simulations for integrated solar water splitting systems, and develops electrocatalysts as well as electrochromic materials.

ANDREAS PFLUG

Group Manager, Simulation
Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany

Andreas Pflug has studied Physics at University of Hannover and made his Diploma Thesis at the Institute for Solar Energy Research Hameln (ISFH). In the following, he worked at ISFH on modeling surface recombination dynamics in silicon solar cells. Since 2000 he is employed at Fraunhofer Institute for Surface Engineering and Thin Films (IST) where he made his PhD on „Simulation of reactive magnetron sputtering“ in 2006 and since 2008 he is head of the group „Simulation“ which is involved in modelling thin film deposition processes.

VINCENZO M. SGLAVO

Department of Industrial Engineering,
University of Trento, Italy

Vincenzo M. Sglavo is professor of materials science and technology at the Department of Industrial Engineering, University of Trento (Italy). He received the Laurea degree “cum laude” in Materials Engineering from the University of Trento in 1988.

In 1989, he joined the Department of Materials Engineering, University of Trento, as Assistant Professor, and in 1999 became Associate Professor. Since May 1993 to August 1994 he worked as Post Doc Fellow at the Department of Materials Science and Engineering, The Pennsylvania State University, USA where he went back as Adjunct Professor in 2001. He has been appointed as Full professor of Materials science and technology at the University of Trento in June 2019.

His current research interests include fracture phenomena in glasses and ceramics, strengthening of glass by ion-exchange, electrical field-assisted sintering and materials for solid oxides fuel cells. Author of more than 180 scientific papers and 12 patents, Prof. Sglavo is member of the American Ceramic Society, the Society of Glass Technology and the Italian association of professional engineers.

GÜLDEM KARTAL ŞİRELİ

Department of Metallurgical and Materials Engineering,
İstanbul Technical University, Turkey

Dr. Güldem Kartal Şireli is an Associate Professor at Department of Metallurgical and Materials Engineering in İstanbul Technical University (I.T.U). She received her B.Sc. in Metallurgical and Materials Engineering Program of I.T.U with an honor award in 2002 and her M.Sc. and Ph.D. degrees in the same program of I.T.U in 2004 and 2012 respectively. She worked as a visiting scholar in Argonne National Laboratory, USA between 2008 and 2010.

Dr. Kartal Sireli' s research interests include: chemical and electrochemical metallurgy- molten salts systems, recovery and refining of metals; surface modification techniques- diffusion based surface hardening processes and development of green technologies.

In recognition of her innovative research, she received R&D-100 Awards in process science with the design of Ultra-Fast and Large-Scale Boriding in 2012. She has acted as referee in many international journals, and taken part in many industrial projects. Dr. Kartal Sireli authored / co-authored more than 50 papers and gave several invited talks at international conferences. Her published work has received more than 650 citations. She holds 3 patents.

JAMES L. THOMASON

Department of Mechanical and Aerospace Engineering, University of Strathclyde, United Kingdom

Jim Thomason has 25 years industry experience, at Shell Chemicals and Owens Corning Fibreglass, leading global fibre and composite product development programmes involving extensive fundamental research and development of glass fibre sizings, interfaces and composites structure-property relationships. In 2007 he moved to the University of Strathclyde where he was appointed Professor of Advanced Materials and Composites. He now leads the Advanced Composites Group whose mission is to generate industrially relevant fundamental understanding of reinforced polymer composites. His research group is highly active in the field structure-(re)processing-performance relationships in composites with a strong focus on sizings and interfaces in glass fibre reinforced composites and the recycling, regeneration and reuse of glass fibres recycled from end of life composites and composites manufacturing waste. He has recently published two review books on Glass Fibre Sizings.

EKATERINA TRUSOVA

Glass and Ceramics Technology Department, Belarusian State Technological University, Belarus

Ekaterina Trusova is Associate Professor at the Glass and Ceramics Technology Department, Belarusian State Technological University. The Doctor of Philosophy degree in Technical Science was awarded in 2010. Seniority in research is 14 years. The main research area is glass and glass-ceramics technology. Her group of researchers has quite serious experience in the development of various photo-, up-conversion, and radio-luminescent materials.

STEPHAN ULRICH

Project Manager
Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany

Dr. Stephan Ulrich is researcher at the Fraunhofer Institute for Surface Engineering and Thin Films IST in Braunschweig (Germany). He wrote his doctoral thesis at the Institute for Solar Energy Research Hameln / Emmerthal (ISFH) on CdTe thin-film solar cells. Since 2005 he has been working at the Fraunhofer IST in several bilateral and public founded projects, including e. g. development of low-emissivity coatings for architectural glazing, research and development of electrochromic materials, manufacturing of n- and p-type TCOs and development of robust interference based sun-control coatings for automotive applications.

CENGIZ ULTAV

Board Member, VESTEL Ventures, Turkey
Chairman of the Board, TTGV - Technology Development Foundation of Turkey, Turkey

Born in Eskişehir on the 26th of February in 1950. Mr. Ultav graduated from Ankara Science High School and received his BSc and MSc degrees from Electronics Engineering Department (Computer and Control Option) from Middle East Technical University in Ankara, Turkey. He also has Diploma Degree from Philips International Institute in Eindhoven, Holland.

Held technical and management positions at Bimsa AS, Info AS in Turkey and Dornier System Gmbh in Germany, worked as Vice General Manager of NCR Turkey and as General Manager of Sun Microsystems in Turkey.
As a certified consultant by Microsoft on its Solution Development Discipline, he offered consultancy services to holding group companies of Koç, Sabancı and Eczacıbaşı. Worked as an Executive Committee member of Vestel Electronics AS on strategic planning and investor relations since 1995. He is currently a board member of Vestel Ventures.

As a UNDP consultant in Vietnam, he conducted a study for the development of electronics industry. He is founding member of the Turkish Informatics Society (TBV) and the Turkish Unix Users Group. He is awarded by TUBİSAD with “Lifelong Service Reward” in 2005.

Mr. Ultav has been serving in TTGV as Board Member since August 2005 and as Chairman of Board since April 2012.

ALP ÜSTÜNDAĞ

Chair of Industrial Engineering Department
Istanbul Technical University, Turkey

Prof. Dr Alp Ustundag is the founder and the CEO of AR Produkt. He graduated from Industrial Engineering Department of Istanbul Technical University (ITU) in 2000. He got his MBA degree from Bogazici University in 2002 and his doctoral degree from ITU in 2008. He worked in IT and the finance industry from 2000 to 2004. He played a pioneer role in İTÜ Industrial Engineering Department as the head of Big Data Analytics programme. He has established the company in 2016 to conduct advanced analytics projects with his deep and extensive know-how on the topic and IoT technology know-how. He has led many projects relating to the data analytics and soft computing. In 2017, he decided to convert the algoritms to a framework and included augmented reality technology to the product. AR Produkt had been launched as a full fledged end to end AR & AI platform in 2018 and been on the market since then, contributing to its customers with user-friendly and sophisticated solution.

ALEXANDR VINOGRADOV

Director, Biochem Cluster International Laboratory "Solution Chemistry of Advanced Materials and Technologies" ITMO University, Russia

Alexandr Vinogradov was born in 1985 in Ivanovo, Russia. In 2007 he graduated from Ivanovo State University of Chemical Technology and continued his path in science. He got a PhD in inorganic chemistry at the Institute of Solution Chemistry of the Russian Academy of Sciences. In 2008, he graduated from the presidential training program in management. In 2010, he completed an internship in Germany in the direction of innovation management and have got executive MBA diploma. In 2011, he complied a special training at MIPT University "Modern methods of standardization and certification of nanomaterials". In the period 2011-2016 he completed several internships at the University of Leipzig in Germany. In parallel, he completed an internship at the Hebrew University Center for Nanoscience and Nanotechnology. In 2014 Alexandr founded ChemBio Cluster at ITMO University and became a head and a leader together with his brother Vladimir V. Vinogradov. In 2017 he was selected in Belgium as an Ulrich awarder.

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE
combined with
34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

ORAL PRESENTATIONS

ŞİŞECAM

www.glassconference-sisecam.com

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

EMERGING TRENDS AND TECHNOLOGIES IN GLASS INDUSTRY

ŞİŞECAM

www.glassconference-sisecam.com

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:20 – 11:50
Hall	TOPKAPI A
Chair	MEHRAN ARBAB

PCE-BASED ADDITIVES ENABLE THE FORMULATION OF HIGHLY-LOADED, HIGH-PERFORMANCE CERAMIC INKS FOR EXTRUSION PRINTING

Özge Akbulut (Invited Speaker)
Faculty of Engineering and Natural Sciences, Sabanci University, Turkey

Additive manufacturing (AM) has shown its potential to print "functionality" along with "form". Fabrication of ceramic objects/features has become one of the goals of AM since ceramics are hard to process with conventional methods. The capabilities of AM, however, are restricted by the availability of ceramics inks. Current formulations are highly-loaded suspensions of ceramic particles (at amounts 65–75 wt. % for direct-writing, 5–20 wt. % for ink-jet printing). The stability and viscosity-control of these suspensions are sustained through combinations of additives in large amounts (5–30 wt. %). There are two inter-related problems associated with these formulations: i) they utilize linear polyelectrolytes as dispersants and rely on electrostatic repulsion-based stability—the key role of steric hindrance for stability and rheological control of suspensions is ignored, ii) non-optimized chemicals rise a need for the use of many additives in high amounts leading to harder dimensional control and more defects. This conspicuous lack of systematic strategy for designing ceramic inks hinders the ultimate potential of AM. On the other hand, controlling the rheological response of highly loaded suspensions is a well-studied problem in the cement industry and there are several poly(carboxylate ether)(PCE)-based solutions in the market. Although, AM also tackles with the same problem, until now, unlike the cement industry, failed to offer or adopt a much-needed universal solution.
Here, I will be describing the particle-specific design of PCE-based single additives that can offer both stability and viscosity-control in extrusion-printing of ceramic inks. I will be underscoring the choice of co-monomers and side-chain density for three different particle systems—iron oxide, alumina, and zirconia while demonstrating the clear difference between the performance of optimized and non-optimized inks.
Through utilizing less than 1,5 wt.% PCE-based additives in ceramic inks, we are reaching almost theoretical loadings and these formulations can provide i) tighter dimensional control, ii) lower sintering temperatures, and iii) elimination of other additives and hence the burn-out step. There is a clear market for PCEs in AM.

Keywords: *additive manufacturing (AM), PCE-based single additives, ceramic ink*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:50 – 12:20
Hall	TOPKAPI A
Chair	MEHRAN ARBAB

NON-METALLIC SOLAR HEAT CONTROL COATING FOR AUTOMOTIVE AND ARCHITECTURE GLASS

Elmira Ryabova, Zoulfia Nagamedianova, Valentin Ryabov, Semra Bulu
Advenira Enterprises, Inc., United States

The last decade or two have made people, from government officials to regular citizens, realize that with the current population growth and the continued industrial expansion, we face many climate change challenges all the while hoping to stop environmental crisis.
Currently used technologies must be upgraded and re-thought at the very least, or replaced altogether, in order to comply with ever-stringent environmental needs and regulations.
In case of glass, which is widely used in construction and transportation industries, the ultimate goal is to make it as energy efficient as possible, not only in terms of performance parameters, but in terms of manufacturing process efficiency as well. In addition, IoT (Internet of Things), Smart Homes, All-connected and Self-driving vehicles are all waiting for a new technology that can block undesirable wavelengths from solar irradiation, while transmitting mobile and sensor signals both ways.
Non-metallic solar heat control coating, developed by Advenira, can answer all the above questions.
Existing solar heat control solutions rely either on a multilayer stack of Ag film(s) or IR-cut film deposited via magnetron sputtering - a vacuum deposition technology that is highly energy consuming. Ag or IR cut films can only be used in laminated window structure. Also, Ag-films are not RF-transparent, which makes them impractical for the new generation of connected cars.
Advenira's SDN® technology provides an atmospheric synthesis and deposition of a single layer solar heat control coating from non-toxic liquid that solidifies in minutes into a fully cured and inert film which is superior to Ag-based or IR-cut films in terms of performance and mechanical properties.
Overall savings that can be achieved by transferring to SDN® technology are 16X money-wise and 28X environmental footprint-wise.
Advenira has also authored a non-metallic solar heat control technology not only for automotive glass windows, but for polycarbonate as well.

Keywords: *glass, polycarbonate, non-metallic solar heat control coating, energy saving technology, environment*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:20 – 12:40
Hall	TOPKAPI A
Chair	MEHRAN ARBAB

FUNCTIONAL MULTILAYER WINDOW COATINGS ENABLING SYNERGISTIC INDOOR AIR CLEANING AND ENERGY EFFICIENCY

Lars Österlund
Uppsala University, Sweden

The possibility to increase human comfort and reduce the global footprint of buildings is a powerful driving force for introduction of new building technology. Here we demonstrate that indoor air cleaning windows with sustained activity can be realized using advanced sputtering technologies and surface functionalization methods. The technology is based on solar light activated pollutant degradation at the surface of an inner window pane. Three steps are to achieve these improved functions are presented. First, we show that controlled facet-texturing of anatase TiO2 films increases the catalytic activity up to one order of magnitude [1]. Second, surface functionalization of the films by sulfate and nitrate groups renders the surfaces resilient towards deactivation in dry conditions [2,3]. In such films bonding of acidic intermediates originating from pollutants is avoided which otherwise deactivate their surfaces. In addition, the wetting properties of the TiO2 films are also modified to make them repel fatty acids and thus possess excellent anti-greasing functionality [4]. Finally, TiO2 is deposited on a thermochromic VO2 film to make a bilayer structure [5]. The VO2 film is heated by near-infrared light absorption above the critical temperature for the semiconductor to metal phase transition. The result is an increased temperature of the overlaying TiO2 film and enhanced photocatalytic activity due to faster reaction kinetics and by shifting the water gas-surface equilibrium coverage to freeing surface sites for reactant molecules. We generalize the results, and discuss their implications for green building technology and possible scenarios for their implementation.

Keywords: *multilayer, coatings, air cleaning, energy efficiency*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:40 – 13:00
Hall	TOPKAPI A
Chair	MEHRAN ARBAB

METAL OXIDE NANOPARTICLES AS CHARGE SELECTIVE LAYERS FOR FULLY INORGANIC PEROVSKITE SOLAR CELLS

Kerem Çağatay İçli, Ahmet Özenbaş
Middle East Technical University, Turkey

Perovskite solar cells have been attracting tremendous attention from glass industry and researchers around the world, as efficiencies up to 22% have already been achieved. They have emerged as a competitor to silicon based photovoltaic technology, however highly unstable polymeric charge selective layers are the major drawback for perovskite solar cells and limit the mass production and commercialization. Ceramic nanoparticles of metal oxides possess both favorable electronic properties and excellent stability and are considered as the most promising alternatives to organic charge carriers. In this work, nanoparticles of lithium doped nickel oxide (NiO) were synthesized by common wet chemistry methods like precipitation and flame spray pyrolysis methods. Synthesized nanoparticles were employed in fully metal oxide mesoscopic perovskite based solar cells. Flame spray pyrolysis method was also used to synthesize yttrium doped titanium dioxide (TiO2) and magnesium oxide (MgO) nanoparticles. NiO nanoparticles which were produced by precipitation technique yielded 20-30 nm particles sizes with homogeneous distribution size and dispersed in isopropanol by ball milling without addition of any surfactants. Stable dispersions were deposited on a mesoscopic perovskite solar cell as the hole transport medium as a replacement of polymeric hole conductors and 10.89% efficiency was obtained for the optimized structure. Lithium doped NiO nanoparticles, ytrrium doped TiO2 nanoparticles and MgO nanoparticles were produced by a unique methanol combustion flame synthesis method and employed as the mesoprous layers in carbon based perovskite solar cells. It was shown that enhancement of the electrical conductivity of the lithium doped NiO and yttrium doped TiO2 layers lead to a reduction of the overall resistivity of the carbon based perovskite solar cell and efficiency of 9.63% was achieved.

Keywords: *perovskite solar cells, metal oxide nanoparticles, sol-gel deposition*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:10 – 09:40
Hall	EMİRGAN
Chair	SÜLEYMAN ÖZÇELİK

INNOVATIVE ENTERPRISE

Mehran Arbab (Invited Speaker)
Global Director, R&T Aerospace Coatings & Sealants PPG Industries, Inc., United States

In this presentation, I will propose that innovation is necessary for sustainable growth, and change is a prerequisite for the vitality of an enterprise. I will describe four classes of innovation and will provide past examples in glass that have created new business models in this industry. Although my focus will be primarily on technology, through these examples I will demonstrate that commercial and supply chain innovations are often necessary for inventions to succeed.

Keywords: *sustainable growth, classes of innovation, supply chain innovations*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:40 – 10:00
Hall	EMİRGAN
Chair	SÜLEYMAN ÖZÇELİK

FIBER OPTICS AND INTEGRATED PHOTONICS ARCHITECTURES USING SPHERICAL RESONATORS AND MEANDERING WAVEGUIDES

Ali Serpengüzel
Koç University, Turkey

Spherical optical microcavities are the building blocks of three dimensional photonics, as linear optical microcavities are the building blocks of one dimensional photonics. Dielectric and semiconductor based lightwave circuit elements are being integrated into fiber optics and integrated photonics. Silicon microspheres lead themselves to various lightwave circuit element applications such as channel dropping filters, tunable filters, and optical modulators using optical fiber half couplers manufactured from single mode optical fibers. Silicon on oxide (SOI)-distributed feedback (DFB) meandering waveguides, as novel integrated optical elements, can exhibit a variety of spectral responses such as coupled resonator induced transparency filter, Fano resonator, hitless filter, Lorentzian filter, Rabi splitter, self coupled optical waveguide, and tunable power divider. We focus on properties of various novel resonators, such as diamond spheres, and SOI-DFB meandering waveguides, and their potential for practical applications in optics and photonics.

Keywords: *fiber optics, integrated photonics, guided wave architecture, spherical resonator, meandering waveguides*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 - 10:20
Hall	EMİRGAN
Chair	SÜLEYMAN ÖZÇELİK

DIGITIZING FURNACE RISK AND RELIABILITY

Yakup Bayram
PaneraTech Inc., United States

With the advent of Industry 4.0, there is a major effort in digitizing, fusing multiple sensory information to capture the manufacturing process. While digital capture of the process is a vital component of the Industry 4.0, It is also equally as important to digitally capture, quantify and track risk and reliability of the assets that are running the process. PaneraTech recently developed and released a radar based, SmartMelter sensor solution, which is quickly becoming industry standard in data-driven health management of glass melters. Along with SmartMelter's deterministic data, glass manufacturers also use traditional visual, endoscopy, and IR temperature to assess the health of the furnace. In this talk, we will discuss a furnace health management platform that digitally integrates multiple sensory information, such as the SmartMelter refractory thickness data, endoscopy, thermal and visual inspections, and maintenance information and discuss ways to quantify the risk and reliability of the entire furnaces in the age of Industry 4.0.

Keywords: *asset risk, asset reliability, furnace risk, furnace life, risk assessment, digital furnace*

Session	Emerging Trends and Technologies in Glass Industry
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:20 - 10:40
Hall	EMİRGAN
Chair	SÜLEYMAN ÖZÇELİK

USING HIGH POWER FIBER LASERS ON PROCESSING LOW EMISSION HEAT REFLECTING THIN FILMS

Çağatay Süner, Osman Burak Okan
Şişecam Group, Turkey

Scraping your windshield in winter is a real challenge. Even if you like the heat, getting into your long term parked car on a sunny hot summer day is very unpleasant. The air-conditioning and defrosting functions of your car can help you but they are time taking, noisy, and energy-intensive.
Şişecam developed a windshield coated with a triple silver coating. Coating consists of ultra-thin layers of metal oxides deposited on glass which reinforce its heat insulating properties. This triple silver coating is multifunctional. It lets in the light but reflects the infrared solar rays and with conductive properties of silver the coating can heat the full surface of the glass in just a few minutes without any visible wires.
Coating contains silver which is likely to be corroded by oxygen and it not only reflects solar rays but also IR and Micro Wave (MW) signals. To prevent corrosion and let IR and MW signals pass through, coating must be ablated all around the glass to create a buffer zone against oxygen and ablated windows must be opened on sun visor area where IR&MW sensors are attached.
The best and fastest way to ablate is to use a laser source for long term durable ablation and precision in shape.

Keywords: *windshield, heated, insulated, defrost, coating, laser, ablation, heat*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

MELTING, FORMING PROCESSES AND BULK PROPERTIES

ŞİŞECAM

www.glassconference-sisecam.com

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:00 – 14:30
Hall	EMİRGAN
Chair	ALİ ERÇİN ERSUNDU

TOWARDS MORE SUSTAINABLE GLASS MANUFACTURE: BALANCING ECONOMIC, ENERGY AND ENVIRONMENTAL FACTORS

Paul A. Bingham (Invited Speaker)
Sheffield Hallam University, United Kingdom

Glass is a material that is fundamental to human society and its technological developments, from architectural and container applications to smart devices and optics. The global glass and glass products market set to reach $250BN by 2020, yet, with 1% of the entire global energy demand, the glass industry is a major industrial source of CO2 emissions.
Many efforts are underway globally to reduce CO2 emissions and the glass industry is playing a role in achieving the strict CO2 emissions limits placed upon it by legislation. However, much remains to be done and scientific and technological developments must be developed and implemented, to help manufacturers meet these demanding targets.
Our research, over many years, and working closely with international glass industry partners, has aimed to help the glass industry meet these CO2 reduction targets, both through reduced fuel (=CO2) and reduced carbonate (=CO2) raw materials, through 3 main routes, each of which will be discussed here:
1) Compositional reformulation. This consists of reformulating the final glass composition in order to reduce the high-temperature viscosity whilst retaining all of the properties and characteristics that make the glass easy to manufacture and use. Our research includes compositional reformulation in order to achieve this and examples from our work will be discussed.
2) Raw materials reformulation. This involves introducing new and alternative raw materials (including by-products from other processes) to augment or partially replace existing raw materials. Our current research includes the use of biomass ashes as glassmaking raw materials and this will be discussed here.
3) Raw materials consolidation. This consists of pelletisation or briquetting of raw materials, or a selection thereof, to enhance melting rates and thus reduce specific energy consumption. A specific example of briquetting of cullet fine particles will be presented here.
Balancing the economic-, energy-, technical-, scientific- and environmental-considerations is highly challenging. Here the author will illustrate the relevant factors and considerations, with the aim of stimulating ideas, debate and discussions around this interesting and vitally-important area of glass science and technology.

Keywords *CO2 emission, glass composition, raw materials, energy*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:30 – 14:50
Hall	EMİRGAN
Chair	ALİ ERÇİN ERSUNDU

ENDLESS FIBRES MADE FROM REGOLITH SIMULANTS

Alexander Niecke[1], Lüking Alexander[1], Meinert Tobias[2], Becker Thilo[1], Haag Markus[1], Gries Thomas[1]
[1]RWTH Aachen University - Institut für Textiltechnik (ITA), Germany
[2]RWTH Aachen University - Institut für Strukturmechanik und Leichtbau, Germany

A feasibility study producing basalt fibres from lunar rock simulants was conducted on a laboratory scale. Thus, the main objective was to synthesise a lunar rock simulant from commercially available terrestrial materials, such as basalt powders or fibres, combined with additives in the form of pure oxides. The substances CaO and Fe2O3 were used to adjust a composition ranging from a low medium silica content to a high alkali and alkali-earth content. In fact, a terrestrial basalt with industrial application was utilized as base material. Once the adjustments of the chemical composition were accomplished, the raw materials were mixed and subsequently melted in a chamber oven at 1450 °C for 1 hour. Afterwards, the melt was quenched in water. Finally, the obtained glass was subjected to an experimental procedure determining the fiberizing range by means of the spinning device illustrated in Figure 2. The spinning temperature was evaluated using a simple method. The onset point was defined at 1200 °C and stepwise increased by 10 °C. For each step the fiberizabilty was checked by pulling the glass drop at the exit of the orifice downwards to the winder. Six small raw material batches were successfully melted at a temperature of 1450 °C, based on initial terrestrial basalts and the addition of components like calcia, and Fe-oxides. Two different lunar simulants called ITALUS-1 and ITALUS-2 were prepared on laboratory scale.

Keywords: *moon, regolith, spinning, fibre, basalt, simulant*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:50 – 15:10
Hall	EMİRGAN
Chair	ALİ ERÇİN ERSUNDU

REDUCING NATURAL GAS CONSUMPTION OF GLASS FURNACES WITH OPTIMELT HEAT RECOVERY TECHNOLOGY

Shrikar Chakravarti[1], Sho Kobayashi[1], Yiğit Kurttepeli[2], Marco Van Valburg[3], Frank Schuurman
[1]Linde Plc, United States
[2]Linde Gaz A.Ş., Turkey
[3]Libbey Inc, Netherlands

Reducing Natural Gas Consumption of Glass Furnaces with OPTIMELT™ Heat Recovery Technology Van Valburg, M. and Schuurmans, F. Libbey Holland, Leerdam, The Netherlands Laux S., Kobayashi H. and Chakravarti S. Linde PLC, Danbury, CT, USA Melting glass with oxy-fuel combustion has been practiced for more than three decades at commercial production scales. In addition to lowering NOx emissions, oxy-fuel melting reduces energy consumption and carbon footprint. By combining oxy-fuel combustion with energy recovery from the flue gas, the fuel and associated CO2 emissions can be further reduced. Praxair, a member of the Linde group, has developed a novel heat recovery technology, OPTIMELTTM Thermochemical Regenerator System (TCR) that recovers waste heat in flue gas from oxy-fuel glass furnaces. The flue gas heat is recovered in regenerators and returned to the furnace as hot syngas where it is combusted with oxygen. The TCR system is expected to reduce NG consumption by about 50% vs recuperative furnaces, 30% vs air-regenerative furnaces and 20% vs oxy-fuel furnaces. The OPTIMELT technology was first successfully commercialized in 2014 at a 50 tpd container glass furnace in Mexico. The next OPTIMELT™ TCR system was deployed on an oxy-fuel fired tableware glass furnace at Libbey Leerdam in The Netherlands. This system has been in operation since November 2017. The operational experience, performance, and glass quality results from the first year of TCR operation will be summarized and compared to the results of the conventional oxy-fuel furnace without the TCR. Finally, at both OPTIMELT TCR system installations, little deposit accumulation has been observed after multiple years of operation. A likely explanation is that sodium sulfate deposited during the heating cycle is being vaporized during the reforming cycle. Chemical equilibrium analysis identified stable salt species under both oxidizing and reducing conditions. However, evaporation rate of Na2SO4.

Keywords: *furnace, heat recoverytechnology, oxy-fuel, combustion*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:10 – 15:30
Hall	EMİRGAN
Chair	ALİ ERÇİN ERSUNDU

EXPERIMENTAL TECHNIQUES TO STUDY GLASS MAKING WITH A DECREASED CO_2 FOOTPRINT AND USING LESS ENERGY

Mathi Rongen, Penny Marson
CelSian Glass & Solar, Netherlands

The glass industry is waking up to the responsible environmental call to reduce both the required energy and the CO_2 footprint of the glass melting process. This presentation describes some of the results from CelSian's experimental set ups applied to carry out investigations into lowering the required energy and reducing the generated CO_2 for glass melting. The examples shown include comparison of the heat demand of different batches; preliminary results of a melting observation trial in a laboratory scale cold top furnace, and techniques to compare the reaction sequences of batch to glass reactions (High Temperature Melting Observation combined Evolved Gas Analysis).

Keywords: *glass melting, CO_2 reduction, energy saving, experimental techniques*

Session	Melting, Forming Processes and Bulk Properties "Refractory Challenges for Glass Melting Technology Development and Maintenance"
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:10 – 09:35
Hall	TOPKAPI C
Chair	SEFPRO

NEW TUCKSTONE SOLUTION FOR SUSTAINABLE GLASS MELTING FURNACE

Thibaut Chuffart, Pierrick Vespa, Isabelle Cabodi, Michel Gaubil
SEFPRO, France

Tuckstones are the first superstructure parts in glass furnaces: the whole superstructure stability relies partly on their performances. A block rupture at an early stage of the furnace lifetime can be a critical issue (superstructure destabilization, tank block corrosion increase etc.) and generally requires high maintenance costs induced by hot repair processes. Stresses undergone by these parts during glass furnace operation will be assessed thanks to experimental measurements, post-mortem analyses and endoscopic observations. With a numerical simulation study of stress field evolution support, we will discuss design a new refractory solution for tuckstone system including suitable materials, innovative fused-cast block shapes, and a specific insulating board associated. Some evidence of new solution advantages will be eventually presented in particular through some ongoing industrial tests. With this new improved bilayer composite solution for tuckstone application, SEFPRO can provide more stable superstructures but also slow down corrosion rate of metal lines thanks to better and longer-lasting protection from radiative thermal transfer and from corrosive rundowns.

Keywords: *refractories, fused cast, tuckstone, superstructure glass furnace, thermomechanical numerical simulation*

Session	Melting, Forming Processes and Bulk Properties "Refractory Challenges for Glass Melting Technology Development and Maintenance"
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:35 – 10:00
Hall	TOPKAPI C
Chair	SEFPRO

GLASS MELTING TODAY AND IN THE FUTURE – THE SORG HYBRID MELTER TECHNOLOGIE

Hartmut Hegeler, Matthias Lindig
Nikolaus Sorg GmbH, Germany

The topics of CO_2 reduction and energy from alternative sources are being widely talked about. The origin and availability as well as the costs, notably for CO_2 certificates, make the situation difficult for glass manufacturers to calculate, especially when investing in new plants. The glass industry in particular as an energy-intensive industry is severely affected by this, even if the share of the glass industry in the overall CO_2 emissions is rather subordinate.
In the speech, SORG gives a brief outline of the current situation regarding emissions and the current status of developments. What possibilities exist today to reduce CO_2 emissions? The presentation ranges from plant optimization to plant modification and the installation of energy recovery systems such as the SORG® Batch Preheater.
The future of conventional fossil-fueled melting plants is more than questionable in the long term. Electric melting is state of the art at SORG. However, for technological reasons it can often not replace 100% of the conventional melt. Also, commercial reasons (electricity price) make the technology for mass-products currently uneconomical. The future development of energy prices, energy sources and certificate prices for CO_2 is unpredictable.
In the case of a required investment, the question arises for the plant operator as to which technology has a future. SORG can give the answer here with the SORG® HYBRID melting furnace. This furnace type is designed to be operated with a fossil fuel/electricity mix at the ratio of 80/20, but can also be operated with a 20/80 ratio. This furnace concept is presented and discussed in detail.

Keywords: *CO_2 emissions, energy reduction, batch preheating, hybrid melter, blister count, mathematic modelling*

Session	Melting, Forming Processes and Bulk Properties "Refractory Challenges for Glass Melting Technology Development and Maintenance"
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 10:25
Hall	TOPKAPI C
Chair	SEFPRO

DEPOSITION AND EVAPORATION OF CONDENSABLE VAPORS IN THERMOCHEMICAL REGENERATORS: SELF- CLEANING MECHANISMS IN THE OPTIMELTTM SYSTEM

Shrikar Chakravarti[1], Poravee Orawannukul[1], Sho Kobayashi[1], Oscar Verheijen[2], Marco Van Kersbergen[2]
[1]Praxair, Inc. a member of the Linde Group, United States
[2]CelSian Glass & Solar BV, Netherlands

Air heating regenerators used for glass melting furnaces are prone for plugging due to formation of salt deposits in the checker channels. Thermal cleaning to melt deposits is difficult and time consuming. Even with periodic cleaning and heat recovery performance deteriorates significantly with time. The mechanism of deposits formation is well understood. Alkali vapors in flue gas such as NaOH and NaBO2 react with SO2 and O2 upon cooling and form Na2SO4 and other species, which condense and form liquid and solid deposits on heat exchanger surfaces. In a commercial OPTIMELT thermochemical regenerators little deposit accumulation was observed after two and half years of commercial operation. Due to the cyclic change of checker atmosphere in the thermochemical regenerators Na2SO4 deposit is vaporized in the reducing atmosphere during the heat recovery cycle (i.e., reforming cycle). In order to elucidate this "self-cleaning" mechanism chemical equilibrium analysis was conducted to identify stable salt species under oxidizing and reducing conditions. The evaporation rate of the Na2SO4 under a simulated regenerator condition was measured in the lab-scaled setup and compared with the theoretical deposition rate of the Na2SO4. This paper reports the results of the thermodynamic analysis and the laboratory test.

Keywords *thermochemical regenerators, furnace technology*

Session	Melting, Forming Processes and Bulk Properties "Refractory Challenges for Glass Melting Technology Development and Maintenance"
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:25 – 10:45
Hall	TOPKAPI C
Chair	SEFPRO

REVIVAL OF FROZEN THROAT FOR ELECTRICAL OPAL GLASS MELTING FURNACE

Ramaswami Velayudhan
Borosil Limited, India

Recovering frozen throat for opal glass electrical melting furnace (Borosil Limited, Jaipur, India) Frozen throat is a major problem encountered by glass manufacturers around the world especially during start up of a furnace or during stoppage of production for long duration due to machine breakdowns etc. The problem is more accentuated by the throat design itself and submerged throat furnaces have more probability of a frozen throat. Typical solution involves drilling of throat and inserting electrodes and bubblers and applying electric power to melt the glass in the throat. This case study involves a cold top electric furnace which had electrodes already installed in the throat area and riser. The throat cover blocks have been corroded and eroded by the corrosive opal glass which required cooling of the throat and then replacement of the blocks. However the restarting of the frozen throat was a challenge as the glass temperature had fallen below 330 deg C. As the electrodes in the melter as well as riser are to be safeguarded as the molybdenum electrodes can be oxidised easily at elevated temperatures, possibility of using burners to melt the frozen glass was not an option.

Keywords: *opal, glass, throat, frozen, sanjeev , borosil, ramaswami*

Session	Melting, Forming Processes and Bulk Properties "30 Year Chimney Blocks"
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:20 – 11:45
Hall	TOPKAPI C
Chair	RHI MAGNESITA

FROM IDEA TO PATENT

Thomas Rouy-Beltran
Sales Manager Glass, Wiesbaden, Germany

Regenerator is one of most important parts of glass melting furnace. The heat of the waste gas will be stored in the checker bricks in the regenerator. The combustion air will take this stored heat and be heated up before meeting the fuel.

End of 1970's and begin of 1980's the first patent was published for chimney blocks as checkers bricks. Nowadays more than 50% of the regenerators worldwide use chimney blocks. This paper will give a review for relevant patents for chimney blocks.

Keywords: *chimney blocks, checker bricks*

Session	Melting, Forming Processes and Bulk Properties "30 Year Chimney Blocks"
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:45 – 12:10
Hall	TOPKAPI C
Chair	RHI MAGNESITA

DEVELOPMENT OF CHEMICAL COMPOSITION FOR CHIMNEY BLOCKS

Rongxing Bei
Marketing Manager Glass, Wiesbaden, Germany

Magnesia bricks were used for the first time in the glass industry during the 1940s because fireclay bricks and silica bricks were unsatisfactory.

Since that time basic bricks, namely magnesia bricks and bricks containing magnesia, have been widely applied in the glass industry, especially in glass melting furnace regenerators.

This paper will review the different compositions for the chimney blocks from the last 30 years.

Keywords: *chimney blocks, magnesia bricks*

Session	Melting, Forming Processes and Bulk Properties "30 Year Chimney Blocks"
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:10 – 12:35
Hall	TOPKAPI C
Chair	RHI MAGNESITA

DEVELOPMENT OF SHAPES FOR CHIMNEY BLOCKS

Sandra Fischer
Sales Manager Glass, Wiesbaden, Germany

The advantages of chimney blocks are high mechanical stability and high efficiency for heat exchange. These advantages are realized with different shapes of chimney blocks, for example chimney blocks are produced with and without a hole on the side wall.

This paper will describe different shapes of chimney blocks and the characteristics.

Keywords: *chimney blocks*

Session	Melting, Forming Processes and Bulk Properties "30 Year Chimney Blocks"
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:35 – 13:00
Hall	TOPKAPI C
Chair	RHI MAGNESITA

POST MORTEM STUDY OF CHIMNEY BLOCKS

Rongxing Bei
Marketing Manager Glass, Wiesbaden, Germany

After furnace campaign the chimney blocks can be taken out for post mortem study. This paper shows examples out of regenerators of float furnaces, container furnaces and sodium silicate furnaces. With chemical and physical analysis, the performance of the chimney blocks will be studied. This study and evaluation are very important to have further development of chimney blocks.

Keywords: *endoscopic observations, fused-cast, corrosion, radiative thermal transfer*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:00 – 14:20
Hall	TOPKAPI C
Chair	VEDAT SEDİROĞLU

PRODUCTION OF HIGHLY TRANSPARENT FLOAT GLASS WITH MID-IRON CONTENT FOR THE EUROPEAN MARKET

Sefa Temiz
Şişecam Group, Italy

In response to increasing customer demand and the recent trends in the European glass market, many flat glass manufacturers have started to produce high transmittance glass products with lower iron content. Şişecam Flat Glass Italy responded to these inquiries by developing a cost effective mid-iron glass composition. Typically, Fe_2O_3 content of clear flat glass produced by Şişecam Flat Glass is between 0.070-0.075% whereas the target Fe_2O_3 ratio for mid iron clear glass is 0.045-0.050%.

In this talk, we will present an overview of an on-the-fly regular-iron to mid-iron compositional change on a float furnace and share our observations towards achieving minimal transient waste glass. We show that the simultaneous monitoring of optical characteristics such as transmission and discoloration behavior are central for a robust transition. We also show that glass defects stemming from higher furnace temperatures and altered melting kinetics can be minimized with a tightly monitored transition wherein an approximately 0.001-0.002% daily decrease in iron content is sustained until the Fe_2O_3 content in the glass reaches down to 0.045-0.050%.

Keywords: *glass production, glass chemical composition, color and optical properties, process monitoring*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:20 – 14:40
Hall	TOPKAPI C
Chair	VEDAT SEDİROĞLU

RING MECHANISM OF CENTRIFUGAL MOLD

Samet Bora, Samet Gündüz
Şişecam Group, Turkey

Ring mechanism of centrifugal molds are adapted for spinning process in tableware industry. Spinning process is based on the centrifugal effect of rotation and formation of the gobs. Spinning processes are continous and they can offer production rates comparable to the existing alternative processes depending on stack and cost. The most important disadvantage of the spinning method is the limited product range in comparison to processes such as the press forming process.

Press Forming process ensure diversity in production with two-three part molds and produces clear shapes thanks to the ring mechanism and the pressing mechanism. Spinning processes are preferred based on the expectance of the manufacturer, quality, cost and an assessment of advantages and disadvantages. In spinning processes, product edge formation, the resulting shape and clearness is controlled with rotation cam, gyroscopic effects of rotation and gob falling differences. This differences and operational faults are minimized with funnel but they are not completely obliterated, therefore, many more faults in following décor process may arise. In this study, we try to integrate ring mechanism to the monopart molds of spinning machines and use the gyroscopic effect to drive the ring mechanism which ensures the centrifugal drive of molds. Partial ring mechanism can be closed over the mold piece by piece. Counter-weight positioned down part of each ring arm part. In the stop position of mold, counter-weight falling down with gravity vector immediately causes ring part to move away from mold. When the mold drives with motor up to shaping angular velocity, counterpart start to move up with centrifugal vector and ring part come up to mold. At the set velocity rings lock each other above the mold.

Consequently, ring mechanism application in the spinning mold may reduce a costs with contributions of more stock and product range and contribute to product quality with clear shapes and eliminated production faults.

Keywords: *ring mechanism, spinning process, centrifugal mold*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:40 – 15:00
Hall	TOPKAPI C
Chair	VEDAT SEDİROĞLU

INLINE BORING PROCESS

Tahir Onur Bakır, Samet Gündüz
Şişecam Group, Turkey

Inline boring process is applicable to stop & go (indexed) and press forming processes. Indexed processes are especially proper choices for press forming applications which have idle and stable cycle steps. Stationary and single mechanisms provide alternatives for different forming options in the stable and idle cycles. Set-up process parameters for loading, discharging, cooling and burning steps are smooth and this provide additional flexibility for controlling production. On the other hand, the major disadvantages of the indexed (stop and go) production set-up are longer cycle times and limited production throughput. Planning in light of these advantages and disadvantages, provides dynamic and flexible decision making environment for cost cutting, improving productivity and maintaining demand and production balance.

Currently, running production with conventional parameters for glass lids require static and stable operation cycles, therefore, the press forming production and/or centrifugal spinning machines are operated in tandem with secondary drilling processes such as laser and water jet cutting. Along with continuous production lines, bridging production lines are operated and are supported by suitable automation software which provide automated transitions between continuous and stepping processes.

In this study, we describe an inline boring process activated during interruption stops and relies on an incineration method along with post processing steps. This study is applicable for all continuous production processes that require indexed forming applications and potentially reduce investment requirements.

Keywords: *inline, boring, tableware, index ,continuous systems, glass lid*

Session	Melting, Forming Processes and Bulk Properties
Date	NOVEMBER 22, 2019, FRIDAY
Time	15:00 – 15:20
Hall	TOPKAPI C
Chair	VEDAT SEDİROĞLU

POLYMERIC MATERIAL USE IN GLASSWARE PRODUCTION PROCESS (HOT END)

Samet Gündüz, Samet Bora
Şişecam Group, Turkey

Bearing elements comprising shaft and bushing pairs are frequently used as bearing elements in many points in glass manufacturing machines. Their widespread use is due to their simple manufacturing methods, low installation, maintenance and repair costs. However, the greatest disadvantages are the high surface contact areas and the absence of a rolling element between the two components.
In the production of glass, pin, bushing bearing elements are used in the mold holder mechanism in press blow machines. The elements used here are exposed to the corrosive effect of chemicals such as hot or soapy water originating from the manufacturing process. Mold arm pins and bushings wear at a level of 2 - 3 mm in a short time due to the abrasive effects of process water. Accordingly, the machine downtime, planned maintenance times and thus the operating and maintenance costs increase.
In this study we report the search for alternative materials which can withstand exposure to soapy water, temperature, dirt etc. in bearing components. We show that polymeric materials are promising candidates for improving the abrasive wear resistance. For the press blow process the most suitable polymer bushing isselected by entering the design constraints to a material selection program. TR28 press blow machine is used as a pilot line and trials with the new material produces a 0,03 mm wear value in 1 year.
We note that the high wear resistance of the polymer bearing elements, renders them applicable in many different cases in glass industry. Our approach for introducing polymers to wear problems at the hot end hold the potential to reduce glass production costs due to less downtime and improved production output.

Keywords: *polymeric materials, abrasion resistance, machinery components, glass forming processes*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

DIGITALIZATION, DATA ANALYTICS AND PROCESS MONITORING

ŞİŞECAM

www.glassconference-sisecam.com

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:50 – 16:20
Hall	EMİRGAN
Chair	TANER BİLGİÇ

AN INDUSTRIAL ANALYTICS AND AUGMENTED REALITY PLATFORM – AR PRODUCT

Alp Üstündağ (Invited Speaker)
Istanbul Technical University, Turkey

As a new industrial revolution, the term Industry 4.0 is one of the most popular topics among industry and academia in the world. Industry 4.0 plays a significant role in strategy to take the opportunities of digitalization of all stages of production and service systems. The fourth industrial revolution is realized by the combination of numerous physical and digital technologies such as artificial intelligence, cloud computing, adaptive robotics, augmented reality, additive manufacturing and Internet of Things (IoT). Regardless of the triggering technologies, the main purpose of industrial transformation is to increase the resource efficiency and productivity to increase the competitive power of the companies. In this presentation, AR Product platform developed by İTÜ researchers will be introduced which combines Data Analytics with Augmented Reality technology.

Keywords: *keywords augmented reality (AR), industrial analytics, internet of things (IoT), digitalization*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:20 – 16:40
Hall	EMİRGAN
Chair	TANER BİLGİÇ

MACHINE VISION AND AUTOMATED INSPECTION

Bertrand Mercier
Isra Vision AG, Germany

ISRA is well famous within the glass industry as inspection and process control systems pioneer. This strategy has always been triggered by the motivation to increase the glass industry efficiency especially when the market is facing new challenges. Currently, the glass industry is highly demanding in new technologies for a big part driven by the automotive industry that is pulling the quality standards to a next level. Increase of market competition, and new requirements (for example in regard of the next automotive autonomous car generations), makes critical to the glass suppliers to improve their process efficiency and product quality to remains in the competition. To answer that demand, ISRA has been developing during the last years, new measurement and inspection machines to improve both process, and final quality control. The presentation will introduce ISRA's latest innovations in regard of these both aspects. Especially: - How to prevent material loses with proper surface inspection and flatness control upfront the automotive glass processing - How to increase final product quality with new vision systems for curvature, optic, surface, and ADAS camera window control.

Keywords: *inspection, surface vision, quality control, efficiency*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:40 – 17:00
Hall	EMİRGAN
Chair	TANER BİLGİÇ

STANDARDIZATION OF MACHINE INTERFACES

Bergmann Gesine
VDMA E.V., Germany

IoT requires organized communication between devices. Adding machinery (devices) into industrial environments, today, requires individual interfaces with efforts getting out of control. The only way out: Standardization! Standardization requires acceptance by all stakeholders and will likely fail if pushed into the market from outside. That is why VDMA launched a joint team to address standardization of interfaces for machinery used in Glass-Industry. Machine manufacturers, future oriented companies from the industry and software suppliers are working together to define the rules of communication, on one hand horizontally - machine to machine as on the other hand vertically - from machine to software systems (MES, ERP...) and in opposite direction. The VDMA group started the work in the field of flat glass cutting, because it´s a starting point in many cases of glass processing. Of cause other parts of glass production and processing will follow. The analysis is driven by the use-cases “Plug and Produce” and “Condition Monitoring”. The information modelling will continue addressing further use-cases like total traceability, capacity planning and machine maintenance. Some months ago the VDMA group offered the possibilities to join this group by transferring the group into an OPC-foundation joint working group. At the moment we are transferring the structures developed until summer into an OPC-companion specification. First CS-document should be available in the first half of 2020. The presentation gives an overview of the previous work and the further steps until mid 2020.

Keywords: *glass machinery, standardization, interfaces*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 21, 2019, THURSDAY
Time	17:00 – 17:20
Hall	EMİRGAN
Chair	TANER BİLGİÇ

CONNECTED BURNER

Luc Jarry
Air Liquide, France

Oxy-combustion is an established technology for many industrial sectors, as for the glass industry. Recent development of connected-burner by Air Liquide is done thanks to digitalization in this Industry 4.0 generation and by focusing on the burners ecosystem. The connected burner, using telecommunication device, feeds the cloud with live data of pressure/temperature/emissivity/sound of an oxy-burner, implemented on a melting tank of glass. Burner record history can be benchmarked anytime to improve process uptime and final product quality. Also, combustion expert macros can be run continuously and their results broadcasted in real time. As an example for a partial oxy-fuel conversion of a side-fired regenerative (air-fuel) float glass furnace, the connected burner introduced in the air combustion chamber, can be monitored and its combustion regulation set points can be challenged and adjusted thanks to Cloud computing and projection power. The presentation aims at introducing this new technology and describe opportunities and means of control that digital is offering with a connected burner. Luc Jarry - Air Liquide - World Business Line, Glas Market Director, Shanghai, China. Contact Details : +86 136 7162 5763 (Mobile).
Email: luc.jarry@airliquide.com

Keywords: *connected-burner, oxy-combustion, air liquide, oxy-fuel*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:10 – 09:40
Hall	TOPKAPI B
Chair	GÖKHAN KIPÇAK

THE INTELLIGENT ENTERPRISE

İbrahim Halatcı (Invited Speaker)
SAP Development Center, Turkey

The virtuous cycle of innovation starts with utilizing big and diverse data to fuel ML/AI and advanced analytic solutions, leading to Applied Intelligence which, in turn, provides new levels of insights and automation for business processes. Reimagined business processes then close the loop by yielding even more data in higher quantities with higher quality. Current state of Artificial intelligence in enterprises is such that 85% of developed AI models never make it to production. 50% of companies still claim to struggle with the complexity of developing and deploying AI applications in a scalable fashion. Regulatory compliance is a major cost item which highlights data protection and governance as a requirement rather than a benefit. At SAP Big Data, we strive to create the platform that ensures a truly scalable, governed, and transparent approach to rapidly deliver business value from business data.

Keywords: *big data, artificial intelligence, business processes, information management, data management*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:40 – 10:00
Hall	TOPKAPI B
Chair	GÖKHAN KIPÇAK

COMPRESSED AIR IN EUROPEAN GLASS FACTORIES

Pascal Van Putten
Van Putten Instruments B.V., Netherlands

The presentation is about energy savings measures we see in glass factories, especially in the field of compressed air, low pressure blower air and vacuum systems. We will discuss various project we have participated, and the results achieved in these projects. We will also discuss some new trends we are seeing: The growth of permanent monitoring systems and smart control systems in compressed air facilities, and the trend towards machine condition monitoring. Last but not least we will talk about challenges that people face when implementing energy optimization projects in a large organization. Despite all the benefits a modern EMS can offer, success is largely dependent on the users and their will to change.

Keywords: *system assessment by permanent monitoring, compressed air plant control system project at glass factory in the Netherlands, machine condition monitoring solutions, replacing compressed air in production equipment.*

Notes:
Challenges we see:
- Best practices vs daily operation (theory vs human behavior)
- Production (Quality) versus maintenance / energy optimization projects

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 10:20
Hall	TOPKAPI B
Chair	GÖKHAN KIPÇAK

HEYE GLASS FORMING AND INSPECTION – SMART TECHNOLOGY AT ITS BEST

Grégory Lecat
Heye International GmbH, Germany

Digitization has been responsible for delivering many innovative and impressive changes to our lives, almost on a daily basis. Realistically, however, who can really claim to be totally 'smart' and completely in control in this new era? The extent of smart networking and Industry 4.0 solutions is developing so quickly that it can be difficult to keep up. But this is exactly the path we all are committed to following! Heye is embracing Industry 4.0's state-of-the-art developments for the world of glass in the same way we did when inventing the NNPB-process 50 years ago. The focus is on vertical information networks within a glass plant but also on the cross-production value chain. Important elements are the intelligent use of sensor technology as well as the combination of robotics with extended safety standards in order to establish reliable closed loops within the machinery and equipment. The development of innovative technical solutions for the gob and container analysis, automatic swabbing and temperature measurement as well as regulation are some of the key milestones on Heye's roadmap for the future digitalization. These developments will make life easier for glass plant operators and managers. Job safety, performance increase and profit maximization are the main results. The individual marking and tracking of glass container, active communication between forming and inspection area as well as holistic plant data management systems complete the new frontiers of the glass forming, inspection and machine management development.

Keywords: *digitalization, IS-machine, forming, inspection, glass container, performance, automation*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:20 – 10:40
Hall	TOPKAPI B
Chair	GÖKHAN KIPÇAK

THE USAGE OF AI FOR GLASS PROCESS OPTIMIZATION

Harald Zimmermann
Deggendorf Institute for Technology, Germany

Industry 4.0 is not a new invention but a new heading, drawing attention to a rapid process, which brings a change of paradigm for the glass industry:
The glass makers with know-how will be more and more replaced by the process engineers and technicians with know-why, and, of course, by automation.
The basis for that are computerized twins of the real processes, functioning as bidirectional systems. On one hand it constantly saves and evaluates measured data from the real process. On the other hand, it suggests or (automatically) executes further actions based on the past evaluations. This will lead to a self-learning process network: a real expert system. The main aim is to obtain fully automatized processes at a maximum level of speed and quality while keeping a high flexibility.
The technical base for that is a perfect implemented pyramid of automation in all its levels combined with data acquisition and reporting systems fully connected with process model systems. The glass industry started with the discussion about the 4.0 topics about 5 years ago and it is time to make a first review and give a sketch of the next steps together with a clear vision:
Despite great flexibility & complexity, the processes are stable and reproducible with a yield achievement of more than xy%, while x and y depending on the type of glass production, e.g. 94% for container glass production. Further more

- Drones monitor the plant operations
- Robots perform simple activities
- Lines retool for job change automatically
- Administrative duties are largely automated
- Most of the staff are engaged in complex maintenance and IT activities.

What is a digital twin and is there a link to lean management and IMS?
What has the glass industry really achieved till today and what will be the next steps?
What is and will be the role of AI?
These questions will be discussed during the presentation with the help of some examples.

Keywords: *industry 4.0, automation, digital twin, robotics, digitalization*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:20 – 11:50
Hall	TOPKAPI B
Chair	İBRAHİM HALATCI

MAJOR CHORD

Cengiz Ultav (Invited Speaker)
VESTEL Ventures & TTGV Technology Development Foundation of Turkey, Turkey

Major shifts are taking place around a smarter, friction free and sustainable world. Business models are impacted by these shifts as well as changing demands coming from millennials. Strong scientific and technology platforms are developing to reach new levels of productivity and value add in this new and exciting era, empowering young people to reshape the near future. The focus of the presentation is this new platform and the associated dynamics.

Keywords: *sustainability, technology, productivity, smart systems, talent management*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:50 – 12:10
Hall	TOPKAPI B
Chair	İBRAHİM HALATCI

A NEW WORLD OF GLASS MAKING

Paul Schreuders
XPAR Vision B.V., Netherlands

With a more than 20 years experience in development and application of sensors to be applied in the forming process of glass containers, and recently also robotics, XPAR Vision is the specialist and technology leader for hot end sensor and robot technology in container glass. Its overall ambition is to assist the global container glass industry to make its bottles and jars lighter and stronger, produced with zero defects at higher speed. The paper is about ingredients for realizing this ambition. With a strong focus on the glass forming process, difficulties and challenges in glass making will be outlined. From there the path forward to a new world of glass making will be proposed. A specific focus will be on sensors for hot end forming and a new revolutionary blank robot, for the purpose of swabbing blanks and neck rings, but also for executing other functions at the blank side. Last but not least the huge benefits these technologies bring to glass producers will be addressed. Supported by a mega trend against plastics and environmental pollution and by clear requests from major breweries and other glass packaging users to drastically reduce the carbon footprint of the packaging materials, the topic is more relevant than ever before.

Keywords: *machine, vision, sensors, robotics, container, glass, lighter, stronger, swabbing, benefits*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:10 – 12:30
Hall	TOPKAPI B
Chair	İBRAHİM HALATCI

MODERN AUTOMATION SYSTEMS IN BATCH PLANTS AND CULLET RECYCLING PLANTS

Torsten Ullrich
Zippe Industrieanlagen GmbH, Germany

Batch plants for the glass production consist of different types of buildings and devices to store and feed different raw materials and cullet. Nowadays, this equipment and the material transport is controlled automatically.
The presentation focuses on these control systems and covers the following:
An overview of different kinds of weighing systems and process control systems will be given.
Here, system redundancy and safe network structures as well as remote service are of ever-increasing importance.
Mobile apps are used around such a control system.
Production data are stored and displayed in different charts. Dashboards and reports help you to improve the productivity of your plant.
You can display the important data on a computer screen or on a mobile device.
By means of customized apps you can navigate to the different data you are interested in.
The information can be located locally or cloud based.
You can have access to these data from everywhere or just compare the performance of each plant.
Control systems are constantly changing and new technologies are being introduced into the future plant automation. Automation and IT-structures are increasingly growing together.

Keywords: *automation, IT-structures, digitalization, industry 4.0*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:30 – 12:50
Hall	TOPKAPI B
Chair	İBRAHİM HALATCI

PAPERLESS DIGITAL FACTORY

Sebastian Lhotka[1], Okan Sarıkayalar[2], Levent Kılıç[3]
[1]COPA-DATA, Austria
[2]SGE Mühendislik, Turkey
[3]Şişecam Group, Turkey

Moving to paperless Manufacturing. Digital factories are essential in today's world to achieve success in competition and also reduce paper-based storage, document control procedures, integrate with environmental strategies, efficiency in production. Understanding roadmap to achieve digital factory, getting ready and integration process is key points.

Keywords: *digital factory, cloud based factory automation, digital factory*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:50 – 13:10
Hall	TOPKAPI B
Chair	İBRAHİM HALATCI

NUMERICAL STUDY OF A CONTINUOUS ANNEALING FURNACE: TOWARDS SIMULATION BASED DIGITAL TWIN OF THE ANNEALING FURNACE

Ersin Yıldız, Altuğ Başol, M. Pınar Mengüç
Özyeğin University, Turkey

Annealing process has a critical role on the quality of the glassware. The process requires a very precise control of the temperature inside the glass. However, in large scale continuous annealing furnaces only the air temperature inside the furnace could be measured. Monitoring the air temperature profile inside the annealing furnace provides a very indirect information about the annealing process itself. In this study, a computational model of a continuous glassware annealing furnace is developed. The computational model includes the convection inside the furnace, the thermal radiation between the moving glasses and the furnace walls and the conduction inside the glassware. First, the details of the computational approach are explained on an annealing furnace model. Next, the computational costs associated with the modeling of each heat transfer modes inside the furnace are quantified and finally, the capability of the present computational model to serve as a simulation based digital twin of the furnace is discussed.

Keywords: *annealing furnace, digital twin, modeling and simulation*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:00 – 14:20
Hall	TOPKAPI B
Chair	DEVRİM KAYMAK

FACTORY DIGITALIZATION CONCEPT WITH PARTICULAR CUSTOMER CASES

Erçin Temel
Proente A.Ş., Turkey

Proente is ambitious engineering company dreaming to break manufacturing efficiency boundaries, so that Proente perfected the standard Manufacturing Execution System and developed 2 more innovative solutions; predicting defective production & machine failure and executing on predefined scenarios or predictions. These 3 solutions are all that is needed to shut off the factory lights and work at the highest efficiency without human touch.
Proente's main focus is highest efficiency without human touch. To reach our goal, we are going to explain how we helped factories with particular samples such as quality problem predictions before it occurs or welding processes parameter optimization etc.

Keywords: *digitalization, predictive analysis, manufacturing, process optimization*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:20 – 14:40
Hall	TOPKAPI B
Chair	DEVRİM KAYMAK

COMMODITY RISK MANAGEMENT IN THE GLASS SECTOR

Murat Gençer, Mehmet Çalışkan
Şişecam Group, Turkey

All companies exposure to different types of risks and unexpected circumstances, which must be managed for financial sustainability. As a definition, risk management is the process of identifying, measuring and taking actions to control risks to an acceptable level. Risks can be considered as threats, but business needs to deal with those. Look ahead, though, and there are many cases to think that there might be many unpredictable risks on the way, more importantly, financial risks. Hence, the concept of "Financial Risk Management" comes into being and it should be taken into account in order to protect against unexpected price changes which may result in higher production costs. This paper aims to analyze a practical model of potential determinants of effective financial risk management by using hedging instruments such as forwards, futures, swaps, and options to mitigate the effects of unwanted price changes in commodities, which are the major components of production cost structure of a glass manufacturing company. For instance, a glass manufacturing company uses commodities (steel, coal, tin, palladium, and silver) as raw material and energy (natural gas) to produce glass can purchase an option or sign a swap to protect itself, thus manage the risk of an increase in the market price. Perhaps the biggest such issue in the following years will be the production cost management strategies to provide substantial risk reduction for those companies which exposure unexpected price changes. Findings from this paper may shed some lights on why a hedging strategy should be a taken into consideration in the financial risk management policy and financial hedging instruments should be involved in the active decision-making processes. Moreover, this paper is written not only for risk professionals but also for people different backgrounds.

Keywords: *financial risk, commodity, hedging, financial derivative instruments, forward, future, swap, option*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:40 – 15:00
Hall	TOPKAPI B
Chair	DEVRİM KAYMAK

3D PRINTING AS A NEW DIMENSION TO MARKETING

Adnan Veysel Ertemel
İstanbul Commerce University, Turkey

3D printing, also known as additive manufacturing uses computer-aided design to build objects layer by layer based on digital models (Vaezi et.al, 2013). It has reached a wide range of application areas including production processes (inclusive of spare parts and logistics) and has started to change the way business is conducted in various industries like medical, construction and food industries (Doherty, 2012).
The most important advantage of the digital medium is measurability. Hence, it's easier than ever to prototype, test and optimize in digital environment. This phenomenon is also applicable to the most fundamental assumptions of a product idea. Using 'lean startup' approach' (Blank, 2013), marketers can make hypothesis tests, at first hand, on whether they can sell their product' with the help of digital tools. Lean approach advises making those experiments as cheap as possible using fast iteration loops and by designing 'minimum viable products'(Ertemel, 2019). Only when their assumptions are validated might the marketers consider developing a full product (Ries, 2011).
Looking from a strategic perspective, 3D printers are set to apply this mindset to the physical world. Conventionally, developing and marketing of a brand new product imposes certain risks. However, by producing just one prototype of a hypothetical product using 3D printers and making demand generation experiments based on numerous combinations enable the marketers to minimize incurred go-to-market risks. In this regard, 3D printing can be viewed as a disruptive revolution in that it sets to bring the most crucial strength of the digital world to the physical World to radically transform the production process in the upcoming in the upcoming 20 years. With all it's hype digital economy is roughly worth 20 trillion USD. However, the size of physical economy is much bigger, 130 trillion USD (Andersson, 2014).

Keywords: *3D printers, marketing, digitalization*

Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	15:00 – 15:20
Hall	TOPKAPI B
Chair	DEVRİM KAYMAK

STATISTICAL ANALYSIS OF POWER QUALITY EVENTS AT THE CONNECTION POINT OF INDUSTRIAL PLANTS: AN OUTLOOK TO POWER QUALITY INTENSITY OF TURKISH GRID SYSTEM

Levent Kılıç[1], Ayşen Basa Arsoy[2], Mustafa Özcan[2], Fatih Mehmet Nuroğlu[3]
[1]*Şişecam Group, Turkey*
[2]*Kocaeli University, Turkey*
[3]*Karadeniz Technical University, Turkey*

The Turkish grid system is undergoing a big transformation. The privatization of the power distribution has now been completed and the share of renewables are continuously increasing,.There are many actors playing various roles in the national energy ecosystem. Synchronizing the actions of all the actors and ensuring supply/demand stability can only be rendered possible through a comprehensive set of regulations and scientifically sound rules of conduct.
On the other hand, despite the presence of regulatory rules, there is no statistical data hinting how this ecosystem could operate effectively. What are the industrial plants faced with? Industrial plants connected to the national distribution or transmission grid at medium voltage level are really exposed to various grid events that affect their production efficiency, cause equipment and system failures and give rise to unexpected malfunctioning.
Without deploying diligently processed data, there is no way to analyze and obtain a clear definition of grid events. In this study, historical data spanning a long period at the point of common coupling will be used to evaluate the existing status and to estimate future events.
In this paper, comparative power quality comparison is analyzed for 12 industrial plants located at five different industrial grid points. For this, we incorporate data pertaining to seven different regions of Turkey through the facilities connected to the national system and compare them with a point from abroad. With this study, Turkish power quality intensity is realized by site data with special care exercised on private sector, private electric companies and industrial plants, and relevant numerical data is reported as a original contribution to the existing literature.

Keywords: *power, quality, grid, events, statistic, sag*

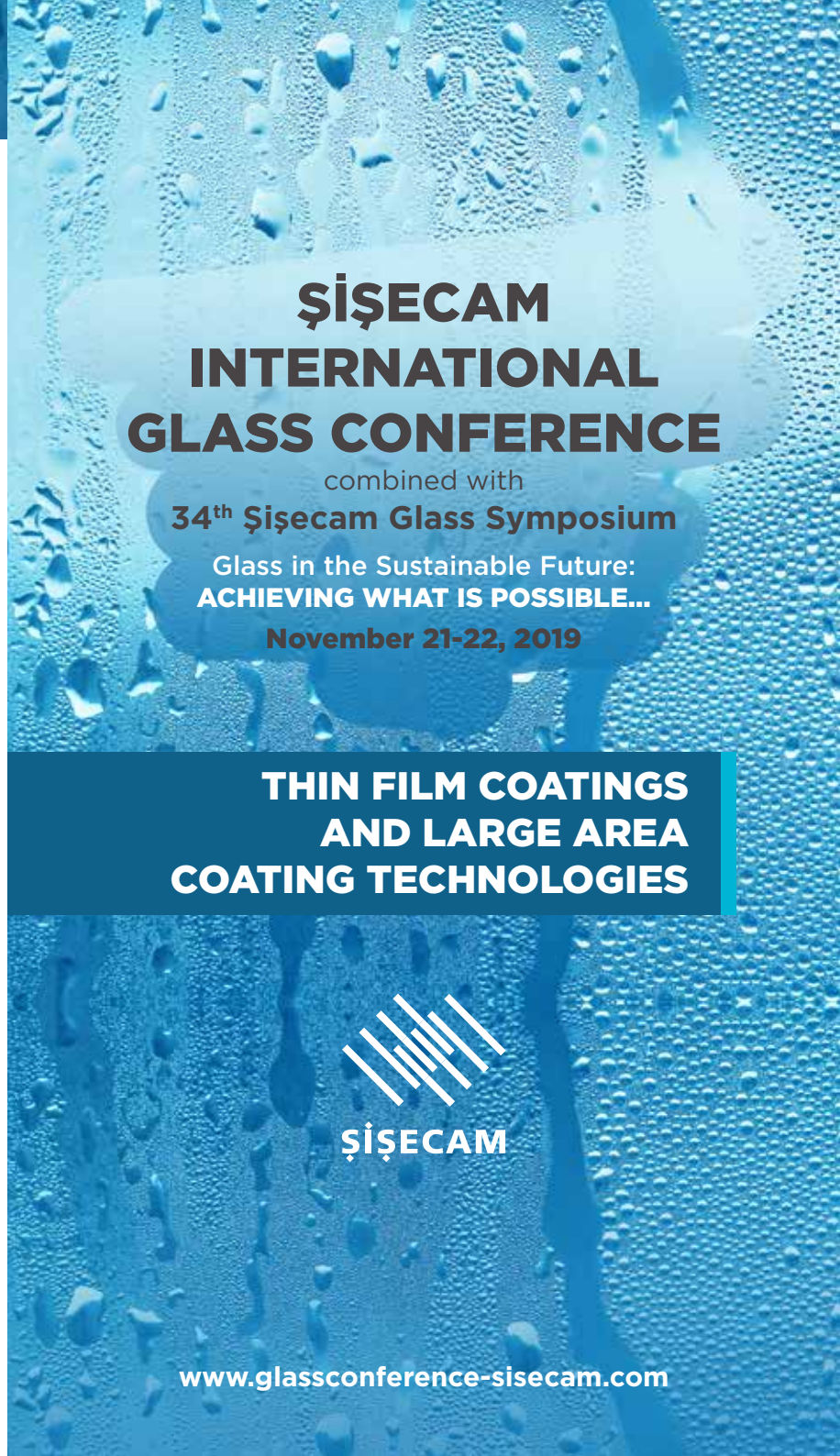
Session	Digitalization, Data Analytics and Process Monitoring
Date	NOVEMBER 22, 2019, FRIDAY
Time	15:20 – 15:40
Hall	TOPKAPI B
Chair	DEVRİM KAYMAK

IMPROVED DEFECT MARKER DETECTION ON FLAT GLASS PANES THROUGH A DUAL CAMERA IMAGE ACQUISITION SYSTEM ON THE OFF-LINE CUTTING LINE

Volkan Türkoğlu
Şişecam Group, Turkey

This study reports the use of a dual camera system for the improved detection of defect markers on jumbo sized glass panes prior to off-line cutting process. The markers assume different shapes and they indicate various glass defects identified on the float line. The ensuing cutting-to-size step is carried out accordingly and all the defected glasses are routed to the glass breaking system. Off-line cutting line predominantly serves to the automotive glass plant which have the lowest defect tolerances in the flat glass business, therefore, the robust elimination of glass defects at this stage becomes very critical.
In the current setting, one of the cameras mounted on the machine vision system provides regular rectangular field images whereas the second camera exclusively operates in a line scanner mode and it is synchronized with the line speed of the conveyor system.
We show that the concurrent use of alternative image acquisition techniques improves the hit rate for detecting defect marker signs and improves customer satisfaction. The marker detection system can still function in case of a single camera failure and this way the machine uptime statistics noticeably improve, bringing an additional benefit.

Keywords: *image processing, machine vision, quality and process control, automation technologies.*


ŞİŞECAM INTERNATIONAL GLASS CONFERENCE
combined with
34th Şişecam Glass Symposium
Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...
November 21-22, 2019
THIN FILM COATINGS AND LARGE AREA COATING TECHNOLOGIES
ŞİŞECAM
www.glassconference-sisecam.com

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:20 – 11:50
Hall	TOPKAPI C
Chair	MUHAMMED HASAN ASLAN

DEVELOPMENT OF ELECTROCHROMIC MATERIALS

Stephan Ulrich (Invited Speaker)
Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany

Electrochromic systems are used to switch the transmittance of light. Common applications include architectural glazing, dimmable rear-view mirrors and automotive sunroofs. A number of binary oxides of transition metals are predominantly known as active materials that change their transmission during intercalation of lithium ions. However, these materials are often harmful to health, e. g. NiO or expensive, RhO4, IrO2. In addition, a number of other criteria should be met: high and reversible intercalation capability for lithium, high light/dark switching range, neutral colour impression in dark and bleached state, switching voltage compatible with the respective electrolyte, room temperature deposition using cost-effective large-area coating processes. As part of the joint project »Smart Windows of the 2nd Generation 'ECWin2.0'«, new electrochromic materials based on mixed oxides were investigated at Fraunhofer IST. Examples of such material developments and their achieved electrochromic properties will be presented. These include modified VTiOx and TiNb2O7, which is known in the battery sector as a novel anode material. For the first time, production of such layer by sputter deposition and suitability as an electrochromic material could be demonstrated.

Coauthors
Christian Szyszko, Sebastian Jung, Björn Beyersdorff, Jonas Subel

Keywords: *smart windows, electrochromic materials, co-sputtering*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:50 – 12:20
Hall	TOPKAPI C
Chair	MUHAMMED HASAN ASLAN

ELECTROCHROMIC DEVICE TECHNOLOGY

İlknur Bayrak Pehlivan (Invited Speaker)
Department of Engineering Sciences, Uppsala University, Sweden

Electrochromism (EC) is a promising energy-saving technology that makes it possible to control the transmission of solar energy and visible light through a device. It is employed in several new technologies, such as in "smart windows" which are able to provide energy efficiency and indoor comfort and are currently used in modern buildings. The EC technology can be implemented in different ways, for example by web-coating where the active materials can be delivered on foils as a roll, or in the form of large sheets for glass lamination.
Today's smart windows typically include thin films based on tungsten oxide and nickel oxide separated by a solid inorganic thin-film ion conductor, or a layer of polymer electrolyte. Transmittance modulation is accomplished when a voltage is applied between the tungsten oxide and nickel oxide thin films, via transparent electrical conductors, so that ions and charge-balancing electrons are shuttled between the two films.
In this talk we will present results covering: (i) pre-treatment and post-treatment methods pioneered by the Uppsala group to enhance electrochromic properties, (ii) progress regarding durability under electrochemical cycling of mixed oxide EC thin films, (iii) enhanced electrochromic properties with nitrogen doped EC films, (iv) a new experimental method, which was recently developed at Uppsala University, for simultaneously studying both the dynamic electrical and optical response of electrochromic materials using a combination of electrochemical impedance spectroscopy and color impedance spectroscopy, and (v) possibilities to combine electrochromism with other applications such as thermochromic control of solar energy transmittance and solar water splitting.

Coauthors
Edgar A. Rojas-González, Gamze Atak, Idris Sorar, Tomas Edvinsson, Lars Österlund, Gunnar A. Niklasson, Claes G. Granqvist

Keywords: *smart windows, tungsten oxide, nitrogen-doping, titanium doping, sputter deposition, thin film, color impedance spectroscopy, thermochromism, water splitting*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:20 – 12:40
Hall	TOPKAPI C
Chair	MUHAMMED HASAN ASLAN

DYNAMIC PHOTOCHROMIC SOLAR CONTROL

Erik Roenneberg, Smagul Karazhanov, Elbruz Murat Baba
Sunphade AS, 2007 Kjeller, Norway

Sunphade uniquely gives windows automatic and dynamic light and glare control without the use of electricity.
Sunphade is an embedded transparent photochromic film material that darkens when exposed to sunlight, but clears in non-sunny conditions. This reduces the heat generated by sunlight inside the building.
Sunphade reduces the need for blinds or permanent dark tinted windows in offices and industrial buildings (non-residential) giving the user enhanced comfort through an unobstructed view and more natural light.
Most importantly Sunphade is also a cost-effective CO_2 emission reduction technology, since it reduces the energy consumption in buildings for air conditioning and artificial light; thus, increasing the energy efficiency.
All factors considered Sunphade increases the value of the building.
Photochromic coatings have several advantages over thermochromic and electrochromic coatings. The performance of thermochromic windows varies with and depend on the temperature. Electrochromic windows need a control system and electrical installations, while the efficiency of photochromic windows is directly proportional to the amount of sunlight.
Sunphade is a nanoscale thin film based on yttrium oxyhydride, which currently works in an IGU environment with controlled atmosphere. Ongoing R&D aims at scaling up the current solution and to develop an IGU with normal argon atmosphere.

Keywords: *dynamic photochromic solar control, inorganic thin films, reactive magnetron sputtering*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:40 – 13:00
Hall	TOPKAPI C
Chair	MUHAMMED HASAN ASLAN

AC MAGNETRON SPUTTERING OF CERAMIC TARGETS FOR DIELECTRIC THIN FILM DEPOSITION

Ignacio Caretti
Soleras Advanced Coatings, Belgium

Industrial deposition of dielectric thin films by AC reactive magnetron sputtering is experiencing a growing tendency towards the replacement of metallic rotatable sputter targets by ceramic ones. The latter may a priori have several advantages over their metallic counterparts, namely little or no hysteresis (i.e. a more stable working point), little or no use of reactive gas (reduced cross-talking) and often a higher deposition rate. However, since ceramic materials are generally brittle and electrically less conductive, the manufacturing of mechanically tough, sputterable cylindrical targets remains a challenge. In this sense, the parallel development of high-end power supplies with more advanced arc management settings has contributed significantly to the sputtering of targets with low conductivities. Understanding the relationship between the material properties and the final sputtering characteristics is crucial for the tailored fabrication of ceramic sputter targets. In this work, we will show a comprehensive study of the sputtering behavior of different metal oxide targets, such as ZnSnOx, ZrOx, etc, prepared by thermal spray processes at Soleras Advanced Coatings. Sputtering conditions will be evaluated and their effect on composition, structure and optical properties of the deposited films will be studied.

Keywords: *AC sputtering; ceramic materials; thin films*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:00 – 14:30
Hall	TOPKAPI C
Chair	İLKNUR BAYRAK PEHLİVAN

SOLUTION CHEMISTRY FOR GLASS INDUSTRY: CURRENT IDEAS AND INNOVATIONS

Alexandr Vinogradov (Invited Speaker)
ITMO University, Russia

The new methods for functionalizing transparent glass find ever new solutions that are due to the development of material chemistry. Leading the security printing, microfluidics and nanobiointerfases lab, I am going to reprepsent a new ideas as a concept for high-tech glass industry and cover the following topics:

1) scratching hologram as a glass coating
2) quantum dots for light harvesting and energy generation as a key part of glass
3) glass grass based on microfluidic part
4) smart coating with hydrophilic and hydrophobic light assisted properties
5) opal glass
6) glass coating for security application

Coauthors
Sofiya Morozova, Sergey Makarov

Keywords: *solution chemistry, security printing, optics, sol-gel*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:30 – 14:50
Hall	TOPKAPI C
Chair	İLKNUR BAYRAK PEHLİVAN

EXPLORING UNCONVENTIONAL WAYS TO IMPROVE SILVER BASED LOW-E COATINGS

Ruslan Muydinov
Technical University in Berlin, Germany

Free electrons of a thin silver layer provide high reflectance in infrared spectral region. This effect is widely used in window panes to save radiant heat inside buildings in cold times and the same outside in hot times. Complex film stack with optimized antireflectance, visible transparency and electrical conductivity is called low-emissivity (low-E) coating. Lesser defectiveness of silver layer stipulates its lower sheet resistance and better low-E performance as a result. In this work we explore some yet unestablished technologies to improve Ag-layer. Two main routes are considered: (i) improvement of a seed layer and (ii) optimization of silver recrystallization. In the first case, we dealt with thin (002)-ZnO layer which provides (111)-texture of Ag-film for better conductivity. Larger lateral size of ZnO grains were of our primary interest. This material being sputtered grows predominantly in (002) direction that result in columnar films with grains of ~20-40 nm width. There are however such approaches as nitrogen or water assisted recrystallization, which allow increasing lateral size to >100 nm. We investigated the influence of ZnO quality onto conductivity of the following Ag-layer. Alternatively, graphene seed layer with flake size of >50 mm was evaluated. Second approach was to appraise a rapid recrystallization of silver layer by the sub-second pulse of Xe-lamp-irradiation. Following ideas were behind this task: energy efficient heating, low cost technical implementation and suppressing of silver-oxygen inter-diffusion. Comparison of such a flash lamp annealing with conventional thermal heating in terms of Ag-layer properties was performed. Among those properties are crystallinity, level of residual stresses, electrical conductivity, visible transparency and mechanical stability. Energy and duration of a Xe-light pulse was varied.

Keywords: *low-E coatings, epitaxy, flash lamp crystallisation, water assisted crystallisation, ZnO, graphene*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:50 – 15:10
Hall	TOPKAPI C
Chair	İLKNUR BAYRAK PEHLİVAN

CHARACTERIZATION OF MULTILAYER THIN FILM COATED FLAT GLASSES BY FEG-SEM TECHNIQUE

Fulya Elgin, Şener YIlmaz, Öcal Tuna, Osman Burak Okan
Şişecam Group, Turkey

Multilayer coatings of various contents and thicknesses are applied to give different properties to the glass surface. Low energy diffusion coated glass (Low-E), anti-reflective coated glass (AR), transparent conductive oxides (TCO) (coatings with metal components) are applied to flat glass surfaces.
This study was carried out using different electron detectors in scanning electron microscope of flat glass samples having different coatings, coating compositions and layer thicknesses under the working conditions specific to each coating type. Thin film coated flat glass samples with different properties were eroded from the cross section by applying appropriate acceleration and discharge voltage with Argon ion milling and prepared for the examination.
The depth of interaction was reduced by using low voltage and low working distance to display multilayer thin film samples through cross-section with high magnification and resolution SEM. Especially in the examination of insulating materials such as glass, working with low voltage and low working distance allows the surface to be viewed without applying a conductive coating. However, this combination of low voltage conditions and sensitive thin film samples reduces the quality of analysis by conventional energy distribution spectrometry (EDS) due to poor characteristic X-ray emission.
The morphological properties of thin-film coated flat glass samples were examined by ultra-high resolution (0.7 nm / 1 kV) field emission (cold cathode type) Scanning Electron Microscopy (FEG-SEM) (Hitachi Regulus 8220). To solve this low-efficiency X-ray signaling problem “windowless” type EDS detector with a large-sized sensor (100 mm2 SDD) EDS (Oxford Ultim Extreme) was used and the chemical compositions of the layers were x-ray mapped with over a wide operating voltage range (1 - 30 kV).
The performance targets of multilayer coatings on flat glass can be achieved by optimization of coating thicknesses and chemical content distributions.

Keywords: *scanning electron microscopy, energy dispersive x-ray spectroscopy, coated glass*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:10 – 15:30
Hall	TOPKAPI C
Chair	İLKNUR BAYRAK PEHLİVAN

AUTOMATED DESIGN FRAMEWORK FOR THIN FILM OPTICAL COATINGS USING MATERIAL AND GEOMETRY OPTIMIZATION

Zeynep Arslantürk[1], Alperen Sezgin[1], Osman Saygıner[2]
[1]*Şişecam Group, Turkey*
[2]*University of Trento, Italy*

Thin-film optical coatings are commonly used elements in optical, electrical and architectural applications. Their ability to manipulate the spectral behavior of the light is especially beneficial in fields such as monitoring, sensing and communication. A thin film optical coating is a material layer made of dielectric or conductive material with nano to micrometer level thickness. Distribution of thin-film coating layers with different thickness and materials enable us to obtain optical systems with unique properties which cannot be achieved with a single material. In this work, we intended to develop a novel design tool which can replace commercial software available in the market. Thus, we propose an automated design framework enabling novel product developments for thin-film optical coatings. The goal of the framework is to build an autonomous design and optimization engine which can tailor the spectral response of an optical system by choosing coating materials, layer thicknesses and the number of layers. To do that, a Transfer Matrix Method is built based on a simulation model of the optical films. Then, the simulation model was coupled with the Genetic Algorithm which mimics the biological evolution. For a design objective, we aimed to lower transmission spectra response through the ultraviolet region while keeping the transmission response at the desired value for architectural purposes. Fabrication limitations were defined in collaboration with Turkiye Sise ve Cam Fabrikalari A.S. - Sisecam Science and Technology Center and they were incorporated in design process.
This project is being supported by The Scientific And Technological Research Council of Turkey (TUBITAK) 2209-B Industrial Research Funding Program for Undergraduate Students 2019/1

Keywords: *thin film optical coatings, optical filter design, thin film modeling design optimization*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:50 – 16:10
Hall	TOPKAPI C
Chair	SERKAN ŞAHİN

AN EXPERIMENTAL DESIGN OF THE MANIPULATIVE SOL-GEL PARAMETERS FOR MECHANICALLY DURABLE, TRANSPARENT AND ANTI-BACTERIAL HYBRID COATINGS

Fatma Beyza Yedikardeş[1], Refika Budakoğlu[1], Esra Özkan Zayim[2]
[1]*Şişecam Group, Turkey*
[2]*Istanbul Technical University, Turkey*

Antibacterial coatings are of high interest for many applications in everyday life including feeding bottles, touch screens and or glass panels. However, the mechanical durability of the glass coatings with an antibacterial effect is required for long-term applications. Based on this motivation, we address two aspects of general interest for solution-based mechanically durable, transparent and anti-bacterial multi-functional hybrid coatings; (1) the experimental design of the coating formulations aiming at the optimization of the manipulative sol-gel parameters including hydrolysis reaction time and precursor ratio; (2) the presentation of the final hybrid formulation. 3-Glycidyloxypropyltrimethoxysilane (GLYMO) and Titanium(IV)isopropoxide hybrid networks containing silver nanoparticles were examined for mechanical endurance and anti-bacterial activity. The highest scratch and wear resistance behaviour were obtained when the precursor ratio is 0.5 (RTi/Si=0.5) precursor ratio. Fourier Transform Infrared Spectroscopy (FTIR) showed that increasing hydrolysis reaction time lead to efficient cross-linking formation between precursors and glass substrate. Nanoparticle formation and electronic states of silver cations in the coating network were confirmed by X-Ray Photoelectron Spectroscopy (XPS) and Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS). The antibacterial activity of the coatings was investigated against Gram (-) Escherichia Coli and Gram (+) Staphylococcus Aureus microorganisms. Consequently, mechanically durable (8N, 9H), optically transparent, and anti-bacterial (log5, 99.999%) hybrid coating formulation has been achieved. It is believed that the final hybrid formulation and the results demonstrated in this work will be a concise guide for novel commercial glass applications.

Keywords: *anti-scratch, anti-wear, anti-bacterial, hybrid, sol-gel*

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:10 – 16:30
Hall	TOPKAPI C
Chair	SERKAN ŞAHİN

DIELECTRIC LAYERS EFFECTS ON CHARACTERISTICS OF THIN SILVER FILMS DEPOSITED ON GLASS BY MAGNETRON SPUTTERING

Ali Emre Gümrükçü, Hakkı Kaplan, Nihan Akın Sönmez, Süleyman Özçelik
Gazi University, Turkey

In order to reduce heat loss due to windows, the coatings which transparent in visible region and reflective in infrared region, are called Low-E coatings. Low-E structures can be developed as metal oxide/metal/metal oxide. Metal oxide layers are used to protect the metal layer and improve film quality. Materials such as ITO, SnO2 and AZO are generally used as metal oxide layers, and Ag, Cu and Au are preferred as metal layers. Ag and AZO stand out among these materials with low cost and good results. In this study, we investigated how the properties of Ag thin film changed with the effect of AZO and Al2O3 dielectric layers. The films were prepared by RF magnetron sputtering technique with using Al2O3(%2) ZnO(%98), Al2O3 and Ag target. AZO and Al2O3 dielectric layers were optimized and the best results were try to obtained from Ag thin film. As a result, AZO and Al2O3 layers had positive effect on Ag thin film structure optically and electrically. In addition, it was observed that the coating parameters of the dielectric layers affect the Ag thin film structure.

Keywords: *sputtering, llow-e glass, Ag thin films, dielectric films*

Notes: Acknowledgments: This work was supported by Republic of Turkey Ministry of Development and The Scientific and Technological Research Council Of Turkey under the project number of 2016K121220 and 117F363 project numbers, respectively.

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:30 – 16:50
Hall	TOPKAPI C
Chair	SERKAN ŞAHİN

MAGNETIC CHARACTERIZATION OF YTTRIUM IRON GARNET THIN FILMS BY FERROMAGNETIC RESONANCE TECHNIQUE

Zürbiye Çapku, Fikret Yıldız
Gebze Technical University, Turkey

Yttrium Iron garnet (YIG) is an important ferromagnetic insulator which has potential applications in magnonics, magneto-optics, spintronics, logic and memory devices. YIG film is generally deposited on garnet substrates whose lattices are well matched with YIG. Therefore, the crystal quality of the film is very good. Meanwhile, Si is another extensively used substrate. We wanted to ensure that such an important ferromagnetic material is used in areas where garnet substrates are unsuitable. In this study, we investigated the magnetic properties of YIG thin films deposited on Si(100) substrates. Therefore, we obtained a series of YIG thin films with different thicknesses by PLD technique and measured the magnetic anisotropy by FMR technique at a fixed frequency of 9,1 GHz. Beside this, VSM measurements were performed at room temperature. Both magnetic measurements revealed that YIG thin films have an in plane magnetic anisotropy which results from large shape anisotropy. The saturation magnetization is around the one for bulk YIG[1]. FMR results showed the presence of the spin wave modes around the main resonance mode, which refers to different magnetic regions along the film surface. We realized that the increase in thickness had such an effect on magnetic properties that narrower FMR line-width was observed. The number of spin wave modes increased and the coercive field decreased.

Keywords: *yttrium iron garnet, ferromagnetic resonance, spin waves, magnetic anisotropy, saturation magnetization*

Notes: [1]Yan Zhang, Jianliang Xie, Longjiang Deng, and Lei Bi, IEEE Transavtions on Magnetics, 2015 Vol. 51, No. 11 Key Words: Magnonics, YIG, Spin waves, FMR, Magnetic anisotropy.

Session	Thin Film Coatings and Large Area Coating Technologies
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:50 – 17:10
Hall	TOPKAPI C
Chair	SERKAN ŞAHİN

DEVELOPMENT OF ELECTROCHEMICAL SENSOR FOR DETERMINATION OF BISPHENOL A

Sevdanur Süerkan[1], Semin Atılgan[1], Fulya Elgin[1], Özge Gördük[2], Burak İzmirlioğlu[1], Yücel Şahin[2]
[1]Şişecam Group, Turkey
[2]Department of Chemistry, Yıldız Technical University, Turkey

Bisphenol A (BPA) is known as one of the important endocrine disruptors that is commonly used in the production of epoxy resins and polycarbonate plastics. It is significant raw material for variety of common products including baby and water bottles, dental fillings, canned foods, food storage containers. Thus, BPA can migrate from the surface of storage containers into food and drinking water that leads to side effects on hormonal activities of human and animal. Therefore, selective and sensitive analytical methods for the detection of BPA has become an essential subject [1]. There are variety of detection techniques, such as fluorescence, high performance liquid chromatography (HPLC), liquid chromatography coupled with mass spectrometry (LC–MS), gas chromatography (GC), gas chromatography coupled with mass spectrometry (GC–MS), and electrochemical sensors used to detect and determine BPA in food and beverage storage containers. Among them, electrochemical method has great advantages regarding its high sensitivity, low cost, excellent selectivity, ease of use, fast response and in situ analysis [2]. In addition, BPA shows electrochemical activity due to its phenolic hydroxyl groups, thus making electrochemical detection of BPA possible [3].
The present study focused on a fabrication of a sensor with the modified electrode for the efficient and sensitive detection of BPA in a simple methodology. Electrochemical experiments were performed using CH Instruments 6054E and Autolab PGSTAT204 and a three-electrode configuration including a disposable pencil graphite electrode which was used as working electrode, a platinum wire as auxiliary electrode and Ag/AgCl electrode as a reference electrode. The electrochemical performance of the modified sensor affecting electrochemical oxidation of BPA was carried out in detail. The reproducibility of the modified sensor was examined with acceptable RSD values. Futhermore, the developed sensor system was applied for the determination of BPA in plastic samples to show the applicability of this method to real matrices.

Keywords *Bisphenol A, electrochemical sensor, food contact material*

References [1] Bolat G., Yaman Y.T., Abaci S., (2018), Sensors and Actuators B 255, 140–148
[2] Yin H., Cui L, Ai S., Fan H., Zhu L., (2010), Electrochimica Acta 55, 603–610
[3] Tian, C., Chen, D., L, Lu, N., Li, Y., Cui, R., Han Z. Zhang G., (2018), Journal of Electroanalytical Chemistry, 830–831, 27–33

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

ENERGY, ENVIRONMENT AND SUSTAINABILITY

ŞİŞECAM

www.glassconference-sisecam.com

Session	Energy, Environment and Sustainability "Glass in Circular Economy"
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:20 – 11:45
Hall	TOPKAPI B
Chair	CELSIAN

COLLECTING AND RECYCLING OF FLAT GLASS – A STEP FORWARD TO A CIRCULAR ECONOMY

Cor Wittekoek
Vlakglas Recycling Nederland, Netherlands

Key learning points:
• flatglass is 100% circular
• but: collecting glass is expensive
• this can be solved when glass companies/industry combine their strength
• to reach a high level of recycling, glass has to be collected separately from other waste
• How can the Dutch system of flatglass collecting and recycling stimulate other countries?

In my presentation I will tell why the Dutch glass industry took the initiative to set up their system of flatglass recycling. How they set up this system, how the system is financed and how it works today. Also the numbers of recycled glass and the re-use in the glass industry. Also which actions we are still taking to reach a higher level of recycling.

Keywords: *flatglass recycling, collecting glass, re-use in glass*

Session	Energy, Environment and Sustainability "Glass in Circular Economy"
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:45 – 12:10
Hall	TOPKAPI B
Chair	CELSIAN

GLASS IN THE CIRCULAR ECONOMY - THE GLASS INDUSTRIES ROLE IN INDUSTRIAL SYMBIOSIS

Aston Fuller
Project Manager, British Glass, United Kingdom

In this paper we explore the current state of play for glass recycling with a particular emphasis on flat glass recycling from the built environment. Case studies on good practice and a discussion of the barriers and challenges facing the construction sector until 2050 are discussed with a particular emphasis on industrial symbiosis and the role glass can play in helping drive a circular economy.

Keywords: *industrial symbiosis, flatglass recycling, construction sector*

Session	Energy, Environment and Sustainability "Glass in Circular Economy"
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:10 – 12:35
Hall	TOPKAPI B
Chair	CELSIAN

CIRCULAR ECONOMY IN THE EUROPEAN FLAT GLASS SECTOR

Cedric Janssens
Glass for Europe, Belgium

The use of recycled flat glass, or "cullet", in the batch presents two major benefits for the flat glass industry: 1°) It reduces the energy needed for melting the raw materials (i.e. 2 to 3% reduction of energy consumption per 10% cullet in the batch); 2°) It reduces the CO_2 emissions, and in particular the process emissions, which cannot be avoided by switching to carbon neutral energy. Closing the recycling loop is therefore considered as environmental, economic and societal sound business by the industry. In the context of a conducive European political environment - with comparatively high energy costs, industrial CO_2 emissions pricing, and societal aspirations for the minimisation of waste and raw material consumption - the European flat glass manufacturers have multiplied the number of initiatives to increase the share of flat glass cullet in the batch over the last decades. Based on Glass for Europe's members estimate, these initiatives resulted in an increase of cullet from 20% to 32% average. This remarkable achievement primarily results from zero-waste policies and collection schemes developed with transformers and processors. While the industrial circular economy loop (pre-consumer) has been virtually closed, some potential remains untapped in the post-consumer phase and in particular in the construction sector. The end-of-life building glass, originating from window renovation or building demolition, is the most important in terms of quantities. Therefore, the industry has engaged with decision-makers and other actors to find solutions to access to this potential source. The presentation will provide answers to key questions such as: What are the quantities of end-of-life building glass available yearly? How can the effective recycling of these glazing be supported? What would be the CO_2 emissions reduction in flat glass manufacturing if the additional cullet were available to the industry?

Keywords: *flat glass, circular economy, recycling, cullet, CO_2 emissions, energy, end-of-life building glass, europe*

Session	Energy, Environment and Sustainability "Glass in Circular Economy"
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:35 – 13:00
Hall	TOPKAPI B
Chair	CELSIAN

AN OVERVIEW OF GLASS FIBRE RECYCLING

Thilo Becker, Alexander Lüking, Markus Haag, Alexander Niecke, Thomas Gries
RWTH Aachen University, Germany

Recycling is widely believed to be a key aspect of any sustainable society. Defined by the European Union as a "recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes", the term leaves significant room for various approaches. This presentation will highlight both current and future trends in the recycling of glass fibres as well as glass fibre reinforced plastics. Furthermore, survey results from both glass fibre manufacturers as well as composite manufacturers are utilized to highlight the current deficits as well as attitude towards recycling within the industry.

Keywords: *recycling, glass fibre, composite, fiberglass*

Session	Energy, Environment and Sustainability "The Electrical Furnace of the Near Future"
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:00 – 14:25
Hall	TOPKAPI B
Chair	EUROTHERM

A COMMERCIAL AND TECHNICAL FEASIBLE FUTURE FOR ALL-ELECTRIC COMMODITY GLASS MANUFACTURING

René Meuleman
Eurotherm by Schneider Electric, United Kingdom

The glass industry needs to continue reducing its carbon footprint, either forced by environmental legislation or by its customers. Since the improvement capability of traditional fossil fuel fired melting systems reached its limits around the year 2000 already, complying to stricter CO_2, NOx and SOx emissions legislation will remain an ongoing challenge for traditional fossil fuel fired systems. Even with technically complex and expensive add-on systems, it is becoming difficult to achieve targets. Electrical heating seems to be the only sensible way forward either perhaps by adding a potential amount of electrical furnace boosting or for sure by changing to all-electric melting methods. Will hydrogen firing become an option, or will it not be energy efficient enough? As explained in many publications this will not be an easy progression but nevertheless it is, in many regions already feasible. This lecture will give an overview of what we have found out during many customer discussions and the result of a recent economical and technical feasibility study.

Keywords: *CO_2 footprint, emissions, electric furnace, hydrogen firing, energy efficiency*

Session	Energy, Environment and Sustainability "The Electrical Furnace of the Near Future"
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:25 – 14:50
Hall	TOPKAPI B
Chair	EUROTHERM

COLD-TOP VERTICAL MELTING FOR LARGE SCALE CONTAINER PRODUCTION

Andy Reynolds
Fives Glass, United Kingdom

All-electric furnaces, based on cold-top vertical melting (CTVM) technology, are successfully and extensively applied to many types of glass at some scale where composition, regional fuel availability, and/or other local factors favour it. Although highly energy efficient, their wider application to large-scale container glass production has been blocked principally by simple fuel economics. But the world is changing, and quickly. Notwithstanding operational cost, the need today to reduce emissions and move towards CO_2 neutral production will not only be driven by legislation but by consumer demand; short-term fuel economics will become irrelevant if a producer fails to meet the environmental expectations of their customers.
CTVM furnaces are currently the only proven technology that offers zero combustive emissions at production capacities, and there seems little doubt that they will have some role in container production of the future. However, successful implementation of the technology requires an appreciation of its associated idiosyncrasies. The need to maintain constant and stable batch coverage, the importance of temperature profile in the melting chamber, how to use convection to separate melting and fining processes in the vertical sense; all these factors play a major role in determining the design geometry, operational characteristics and production flexibility.
As a leading supplier of electric melting technology Fives is engaged in research and development programs aimed at establishing a more complete understanding of the internal processes involved. Through empirical review and CFD modelling; data is being used to both optimise design and performance and to validate extrapolation of design principals to larger furnaces. This paper aims to provide an overview of the work and how from it we can build larger, more energy efficiency and longer lasting furnaces that can meet the expectations of both producers and end-users.

Keywords: *electric melting, glass quality, model of melting tanks*

Session	Energy, Environment and Sustainability "The Electrical Furnace of the Near Future"
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:50 – 15:15
Hall	TOPKAPI B
Chair	EUROTHERM

HYBRID MELTING TANKS WITH HIGHLY FLEXIBLE ELECTRICAL BOOSTING INPUT: A NEW CHALLENGE

Wolf Kuhn[1], Andrew Reynolds[2], Peter Molcan[1], Bruno Malphettes[2]
[1]Fives Stein, France
[2]Fives Stein, United Kingdom

The increasing availability of renewable electrical energy – accompanied by a shift in the energy price structure and the CO_2 taxes - changes the paradigms in commercial glass production. The request on glass melting by electrical energy input will significantly increase in the coming years. Moreover, the availability of 'green' electrical energy is strongly fluctuating in function of the generation mode and meteorological conditions. This requires a melting tank design that is adapted for strong shifts between electrical and combustion energy input. Conventional glass tanks equipped with electrical boosting are limited in their boosting input fraction and are not suited for a strong turn down of combustion input. Vertical electrical melting tanks in warm top versions are limited in their combustion input and are not adapted for waist type withdrawal of float glass. An evolution of the melting tank design is required. Fives developed a new melting tank concept based on a thorough analysis of these limitations - and combining proven construction elements of electrical melting tanks and of combustion based tanks. Modelling studies of this new design will be presented. Steady state operations with either low or high electrical boosting are verified on operational parameters and on stable glass quality. The flexibility of the tank on short term variations of the electrical energy input presents a particular challenge for a stable glass quality. Transient simulations of the melting process are required to study the flexibility of the new concept. The scalability of the new design from mid-size to high tonnages will also be discussed.

Keywords: *glass melting tank, renewable electrical energy, flexible energy input, numerical modeling*

Session	Energy, Environment and Sustainability "The Electrical Furnace of the Near Future"
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:15 – 15:40
Hall	TOPKAPI B
Chair	EUROTHERM

ALL-ELECTRIC MELTING: A FEEDBACK FROM OUT OF PRACTICE

Francois Deblock
SGD Pharma, France

The number of electrical cold top furnaces is rather limited in the world. The large float furnace and container have never experienced this technology or at experimental stage. The electrical furnaces were developed mainly for special glasses as opal glass; lead crystal glass; borosilicate in order to limit the evaporation of boron; lead etc... So the experience shared is limited and among a small number of companies.
Nowadays the CO_2 reduction and energy reduction are giving a new opportunity for cold top furnaces. At the same time the knowhow to operate those furnaces is also rather absent from literature. The document presented has not the pretention to describe in detail the operating conditions with cold top furnace but to list the "top 10" topics to think of in order to run an electrical furnace. After the reviews of those topics some practical benefits will be reviewed. A short comparison with mixed melter furnace will be done as perspective.

Keywords: *electrical cold top furnaces, CO_2 reduction*

Session	Energy, Environment and Sustainability " 2020 NOx"
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:50 – 16:40
Hall	TOPKAPI B
Chair	AMETEK LAND

2020 NOX REDUCTION USING IN-FURNACE THERMAL IMAGING

Philippe Kerbois[1], Neil Simpson[2]
[1]AMETEK Land, France
[2]Simpson Combustion & Energy, United Kingdom

The easiest way to lower the NOx in a furnace is to lower the energy input. Referencing furnace case studies, thermal imaging can be used to optimise thermal profile and establish sources of parasitic air. Optimising both will reduce energy and NOx. Thermal NOx is generated when high flame temperatures are produced and again referencing case studies it is possible to see which flame is generating the NOx and how to reduce. Additional consideration will be given to potential NOx reduction beyond 2020.

Keywords: *NOx reduction, energy, thermal imaging, high flame temperatures*

Session	Energy, Environment and Sustainability " 2020 NOx"
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:40 – 17:05
Hall	TOPKAPI B
Chair	AMETEK LAND

REGENERATION REPAIR FOR NOX REDUCTION

Benjamin Köster
Hotwork International, Germany

What if an unexpected, but major regenerator problem occurs and increases NOx? Which options are available, allowing to repair the regenerator and return to full production as soon as possible? How can you avoid losing months of production if there is no refractory available? Often regenerator problems can occur unexpected, thus a fast and reliable emergency solution is required, is it at all possible? Various options are being discussed within this talk, giving end users an overview of proven technologies for the repair of regenerators (partial and full) with and without production loss. Besides the technology we focus also on the economics and feasibility of the repair method to get NOx back in compliance.

Keywords: *regenerator repair, NOx reduction*

Session	ENERGY, ENVIRONMENT AND SUSTAINABILITY " 2020 NOx"
Date	NOVEMBER 21, 2019, THURSDAY
Time	17:05 - 17:30
Hall	TOPKAPI B
Chair	AMETEK LAND

NOX SUSTAINABILITY – STARA GLASS PRIMARY AND SECONDARY SOLUTIONS AND RELATED EXPERIENCES

Ernesto Cattaneo, Giorgio Minestrini
Stara Glass R&D & Innovation, Italy

Stara Glass has been at the forefront of the innovation in NOx containment in the glass industry for the last ten years, and has developed two effective primary techniques that are being widely appreciated in the glass market. Furthermore, the particular architecture of Stara's Centauro system allows the application of a particularly efficient and cost effective SNCR system, which is coupled with a regenerative performance. The presentation includes the very satisfactory field results of many installations.

Keywords: *NOx reduction, primary techmiques, Centauro, SNCR*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:10 – 09:30
Hall	TOPKAPI A
Chair	ABDULLAH KILINÇ

GAS RECYCLING AND ITS ADVANTAGES

Ellart De Wit, Marco Rep
HyGear, Netherlands

As the focus is shifting towards reduction of harmful emissions, industries are constantly searching for alternative ways to reduce the environmental impact of their processes. At the same time, companies in the glass industry are continuously seeking ways to optimize the glass production process, improving the glass quality and reducing costs. The increasing desire to reduce environmental impact therefore conflicts with the objective to reduce costs and improve product quality. This was the starting point for the development of the Hy.RECmix. This technology has the ability to recover, clean and recycle the vented gases from the tin bath and feed them back into the process. By using this method, the amount of fresh gases that is required for the process reduces, thus leading to lower expenses and less venting. This entails in reduction of harmful emission without jeopardising the product quality. Reduction of environmental impact The development of the Hy.RECmix is to recover the gas mixtures from the tin bath in float glass production and to reuse the gas within the process. In the current production process, significant amounts of hydrogen and nitrogen gas mixture, including pollutants, are vented and left unutilised. This technology has proven to be an effective method for cost reduction as the amount of fresh gases feed will decrease and the carbon foot print of the whole process will decrease as well. The following figure shows the reduction of CO_2 and dust emissions associated to the supply chain of nitrogen and hydrogen.

Keywords: *gas recycling, gas recovery, emission reduction, cost reduction, improve product quality*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:30 – 09:50
Hall	TOPKAPI A
Chair	ABDULLAH KILINÇ

NEW OXY-FUEL CLEANFIRE HRX BURNER – LOWER NOX, FOAM REDUCTION, HIGHER FUEL EFFICIENCY

Piotr Skawinski, Jan Viduna
Air Products, Czech Republic

Air Products has developed the new Cleanfire® HRx™ burner to solve the issue of increased surface foam production in oxy-fuel melting tanks, which has negative effect on glass quality fuel efficiency and refractory life. The culmination of decades of successful, industry-driven combustion innovation, the HRx burner incorporates advanced oxygen staging technology plus on-board burners sensors to enable optimized operation for both high-efficiency melting in the batch region and foam control / elimination in the refining zone. Operation in several commercial installations at container and float furnaces, highlighted in this paper, have proven the burner's ability to control foam while increasing glass quality and fuel efficiency, and lowering NOx emissions.

Keywords: *oxy-fuel, burner, foam, NOx, fuel efficiency*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	09:50 - :10:10
Hall	TOPKAPI A
Chair	ABDULLAH KILINÇ

LARGE SAVINGS AVAILABLE IN THE COMPRESSOR ROOM

Kimmo Pyykönen, Olli Kuismanen
Tamturbo Plc, Finland

Compressed air consumes on average 10% of industrial electricity. Many industries, like the glass industry, requires and benefits from 100% oil-free air and extreme reliability of compressed air. The legacy technologies wear and lose their efficiency within months of use and require extensive service and maintenance. Tamturbo has developed a high-speed turbo compressor that features a better and lasting efficiency coupled with variability of air usage and virtually no need for maintenance (since nothing wears). The technology is based on high-speed electric motors and active magnetic bearings, technologies that have been in use in other applications for decades. We offer on average 10-15% lower electricity consumption, 90% less maintenance cost, remote monitoring and optimization and less risk of oil or PTFE contamination of air (as there is not a single drop of oil or PTFE in our compressor). Furthermore, because of our lowest Total Cost of Ownership Tamturbo and its partners offer this technology as a service. In our Touch-Free™ Air concept the customer only pays for the produced compressed air, at a price which is significantly lower than what they pay now for the compressor, its' service and maintenance and save on electricity at the same time. In his presentation Kimmo will explain how the savings can be identified, quantified and realized.

Keywords: *energy, electricity, savings, compressed air, utilities, maintenance, CAPEX, OPEX*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:10 – 10:30
Hall	TOPKAPI A
Chair	ABDULLAH KILINÇ

OXYGEN CONSUMPTION OPTIMISATION FOR OXY-FUEL FURNACES

Ergür Seven, Turgut Mert Çağdaş
Şişecam Group, Turkey

Depending on the content of natural gas used in glass production areas, there is a theoretical ratio of oxygen/natural gas that should be used. However, this amount of natural gas / oxygen ratio depends on the composition of the glass produced, the quality expected from this composition, the amount of air leakage in the furnace, the age of the furnace, the glass pull from the furnace, the purity of the oxygen used. Even if the oxygen / natural gas ratio is adjusted by considering these parameters, in order to minimize the cost of glass, a new optimization is necessary according to the conditions of the factory, raw material, fuel and electricity costs used in production. Additional parameters mentioned in this study are also taken into consideration. After decreasing the oxygen usage rate in the furnace, Fe^{2+} change in glass, glass color, foam formation on the glass surface were observed and necessary chemical and furnace operational interventions were made to produce the same quality glass.

Keywords: *oxygen, oxy-fuel furnace, combustion, consumption optimisation, energy saving*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:20 – 11:45
Hall	TOPKAPI A
Chair	EUROTHERM

SUSTAINABLE PACKAGING MATERIALS ARE AN ESSENTIAL PILLAR TO SUPPORT OUR BUSINESS

Jan Kempers
Heineken Nederland, Netherlands

HEINEKEN is the 2nd largest brewer of the world and within the company HEINEKEN Netherland Supply (HNS) has a dominant position being the brewer for the domestic market and the brewer of support volume for the rest of the world. Our markets will change, due to climate change, waste issues, regulatory pressure on recycling and the worldwide consequences of implementation of the COP21 agreements. A change in consumer preference will have an impact on our business and therefore we feel the need to transform our supply chains into climate neutral supply chains to our customers worldwide. Packaging materials, in particular bottles, are the largest contributor to the carbon footprint of our supply chain. This presentation will give our motivation and underlying figures and will present our strategy to realize our ambition. It is a wake-up call and an invitation to the glass industry to join us on our mission to change the nature of our packaging material business.

Keywords: *packaging materials, climate change, waste issues, regulatory pressure on recycling*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:45 – 12:10
Hall	TOPKAPI A
Chair	EUROTHERM

THE ENERGY SOURCE OF THE FUTURE FROM AN ENERGY MARKET PERSPECTIVE

Gary Café
Schneider Electric, United Kingdom

The glass industry needs to continue reducing its carbon footprint, either forced by The glass industry, like many, is moving towards a low carbon economy. It's traditional reliance on Natural Gas means it either needs to find a cleaner fuel source or move mountains in the CCS domain. Given the lack of success to date of CCS, most companies and industries are looking to switch fuels. This session will explore some of the key concerns and facets that the glass industry should consider from an energy market perspective.
Hydrogen is clearly a popular discussion point for all industrials at the moment but who will win the race and how much will it cost given how challenging it is to produce, transport and store low carbon hydrogen at scale?

Elec/NG/H2 hybrid models appear an obvious step but what's the cost of running parallel technologies vs. what advantages are there to having both fuel sources available? Can this ultimately be carbon neutral to meet Paris accord deadlines?

All electric is promising, and renewables are only getting cheaper. How can businesses align their strategies with renewables whilst ensuring security of supply? How can all-electric help the grid keep the lights on in a renewable heavy grid and at the same time add new generation to cover themselves in a low carbon fashion?

And then there's a cost comparison consideration. Historically, furnaces were built with only one fuel in mind, so energy markets were seen as something vital but out of your control. Therefore, often relegated to a single line on your opex spreadsheet despite having a much larger €/T impact than any CAPEX or efficiency consideration. In the new world though we have choice. What are the risks built into those choices and how can we help snr managers quantify that risk before investment decisions are made?

Keywords: *natural gas, hydrogen firing, hybrid furnaces, all-electric melting*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:10 – 12:35
Hall	TOPKAPI A
Chair	CELSIAN

FURNACE READY CULLET - QUALITY ACHIEVEMENTS AND CHALLENGES

Mustafa Ürgen
Egeçev Waste Management, Turkey

Glass is an endless material which loops from product to the source and never loses its quality. What we should do to keep the quality of recycled glass for Circular Economy? We need to consider each steps of glass bottles from consumer as a source up to the manufacturer. What are the challenges during this process? How we achieve the high quality Furnace Ready Cullet for an endless life cycle?

Keywords: *ferver, recycling, cullet, quality*

Session	Energy, Environment and Sustainability
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:35 – 13:00
Hall	TOPKAPI A
Chair	CELSIAN

IN THE CENTER OF CIRCLE: GLASS IS GLASS AGAIN

Büşra Demirci
Şişecam Group, Turkey

Economic analyses show that, implementing circular economy principles in fundamental productions of modern industry, may support the solution of many important problems such as climate change, water crisis, land-use and employment. With its 100% recyclable nature, eco-design and modern production technology "glass" is a perfect example of today's circular economy concept in action. As one of the leading companies in the world glass industry, Şişecam Group recognizes advantageous nature of glass in circular economy and aims to implement a circular model into operations which includes the sustainable use of energy and natural sources. In this framework, Group continues to make improvements by adopting the best possible technologies, to increase glass cullet usage and to develop projects to realize the "zero waste" goal as well as to promote the culture of responsible production. Launched in 2011 by Şişecam in collaboration with the NGOs and local authorities, the "Glass is Glass Again" project is one of the most comprehensive circularity projects in Turkey. Aiming to boost glass recycling in Turkey and contribute to a more competitive, resource-efficient circular economy, Group improves the infrastructure for collecting glass packaging waste, streamlines the facilities where glass packaging waste is collected and processed and separates glass waste prior to storage. As of today, approximately 12,000 glass banks have been donated and 550,000 tons of glass packaging waste have been recycled. The resulting reduction in carbon emissions equals 200,000 cars taken off the roads, and the amount of energy saved was enough to meet the heating and hot water needs of 23,000 households.

Keywords: *circular economy, cullet recycling*

Session	Energy, Environment and Sustainability "CO_2 Reduction Using Renewable Energy"
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:00 – 14:40
Hall	TOPKAPI A
Chair	GLASS SERVICE

OPTIONS FOR STEP WISE CO_2 EMISSIONS REDUCTION

Erik Muijsenberg
Glass Service, Czech Republic

The share and use of Electric melting is today steadily growing again. This is not new, as some decennia's ago it already was quite popular. The first furnace that used electric current was built in 1905 following Sauvageon's design was melting glass for window glass production. Since that time many different designs were tried. In more recent decennia's electric melting became less popular due to low price and wide availability of fossil fuels. Just in recent years with the fear of Global Warming and plans for CO_2 reduction the interest in full or partial (Hybrid) electric melting is getting more attention again. The generation of electricity by alternative energy sources is of course a great help here as it brings costs of Electricity finally down and will be CO_2 free. In Europe the average generation of electricity is already in range of 38% by renewable resources such as wind, solar hydro and bio. The question for the future is not if we will have more electric energy usage for glass melting, but if the future will be All Electric Melting (AEM) or hybrid such as GS H2EM that means a balance between using more Bio fuels or Hydrogen some amount of fossil fuels and large amount of electric melting step by step to reduce our CO_2 footprint. The paper will show some examples of the past & present and some ideas for the future strongly supported with mathematical modeling of new furnace designs.

Keywords: *renewables, electric melting, CO_2 reduction, simulation*

Session	Energy, Environment and Sustainability "CO_2 Reduction Using Renewable Energy"
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:40 – 15:10
Hall	TOPKAPI A
Chair	GLASS SERVICE

MODEL PREDICTIVE CONTROL AND MONITORING OF THE BATCH COVERAGE AND SHAPE WITH NIR CAMERA

Erik Muijsenberg
Glass Service, Czech Republic

Glass Service, a.s. (GS), has added proprietary software to its Model Predictive Control (MPC) toolbox to monitor the batch coverage within a melter. It will correlate this batch image to the control of the melter to improve the furnace stability and glass quality. Further steps include the GS MPC control of the batch charging and the combustion process using the MPC. The new GS Expert System ES 4.0TM (ES IV) uses high definition (HD) cameras with near infra-red capabilities to produce an automatic batch analysis and smart software to interpret the batch coverage. The batch coverage is modeled together with the other multi-input and multi-output process variables which can become a more thorough control option to increase the furnace stability and improve glass quality. The GS Expert System ES IIITM can correlate this automatic batch coverage analysis with the crown temperature changes by the Infrared Image Analysis into the ES IV control.

Keywords: *model based control, industry 4.0, near infrared camera vision*

Session	Energy, Environment and Sustainability "CO_2 Reduction Using Renewable Energy"
Date	NOVEMBER 22, 2019, FRIDAY
Time	15:10 – 15:40
Hall	TOPKAPI A
Chair	GLASS SERVICE

LARGE ELECTRIC FURNACES & SUPERBOOSTING - IS THIS THE FUTURE FOR CO_2 REDUCTION?

Christoph Jatzwauk
F.I.C. Germany GmbH, Germany

This paper will, based on looking at current all-electric furnaces in use, which possibilities we haves to use our knowledge on the smaller furnaces to realize concepts for larger furnaces with a high boosting amount in use or preparing straight concepts for hybrid-melter by using super-boosting and / or eventually moving to all-electric furnaces. There is a statutory requirement in Europe to reduce the CO_2 reduction from furnaces by 40% by 2030 and 80% by 2050.
The paper will examine the problems in achieving this and will show the results of modelling of large all-electric furnaces in the range of 300 up to 450 tpd for container and how to convert a float furnace up to 600tpd into a hybrid-melter too.

Keywords: *model predictive control, NIR Camera, infra-red imaging, analysis, glass melting*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

COMPOSITES, BIOGLASSES, CELLULAR AND GRANULAR MATTER

ŞİŞECAM

www.glassconference-sisecam.com

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:20 – 11:50
Hall	NİŞANTAŞI
Chair	SELİM KÜSEFOĞLU

CONTROLLING INTERPHASES IN GLASS FIBRE COMPOSITE MATERIALS

Frank R. Jones (Invited Speaker)
University of Sheffield, United Kingdom

The presentation will review interphase formation in composite materials from glass and carbon fibres, which are conventionally surface treated. The structure of silane coupling agents in the presence of other sizing polymers is considered. Depending on the nature of the matrix and sizing polymers the interphase can be either graded or distinct. The function of the interphase is to transfer stress between the fibres and matrix especially at a fibre-break so as to ensure the material exhibits 'tough' behaviour under load. We know from carbon fibre development that a perfect interfacial bond leads to brittle behaviour whereas with a poor fibre-matrix bond the composite cannot realise its optimum performance. Intermediate surface treatment ensures an optimum interlaminar shear strength and fracture strength. With glass fibres, interphase structure and properties determine the efficiency of the interfacial stress transfer and hence performance. With glass fibre composites the nature of the interface and interphase is controlled by technological choice of sizing and coupling agent. Thus to control the performance of fibre composites other surface engineering techniques need consideration. Plasma polymerisation can be used to deposit a conformal coating, which combines a coupling function with the protection afforded by a polymeric coating. Acrylic acid based plasma copolymers have been deposited onto glass and other fibres and the interfacial performance characterised. The disadvantage of conventional plasma techniques is the use of high vacuum. Atmospheric plasma technologies have been recently developed and are potentially more efficient at providing fibres with a functional coating.

Keywords: *glass fibre composites, interface and interphases, plasma polymerisation*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:50 – 12:10
Hall	NİŞANTAŞI
Chair	SELİM KÜSEFOĞLU

PERFORMANCE IMPROVEMENT AND LASER-INDUCED MODIFICATION OF TRANSPARENT LITHIUM ALUMINOSILICATE GLASS-CERAMICS

Sergey Lotarev, Alexey Lipatiev, Sergey Fedotov, Vitaliy Savinkov, Georgiy Shakhgildyan, Andrey Naumov, Vladimir Sigaev
Mendeleev University of Chemical Technology of Russia, Russia

Transparent glass-ceramics with ultra-low coefficient of thermal expansion (CTE) based on precipitation of nanosized crystals of crystalline phases with negative CTE such as β-eucryptite or spodumene in lithium aluminosilicate glass is nowadays widely applied in engineering from telescope mirrors and ring laser gyroscopes to household appliances. However, an issue of expansion of the temperature range in which CTE is maximally close to zero is still urgent. We studied the effect of antimony oxide Sb2O3 addition on the glass crystallization in a lithium aluminosilicate system and showed that the addition of antimony oxide into the glass composition avoids the effect of glass cracking during crystallization at temperatures above 700°C and provides near-zero CTE (-1,5 - + 0,0)*10^-7 1/°C in range from -80°C to +200°C, which is wider than known for modern commercial LAS glass-ceramics. The introduction of Sb2O3 showed no influence on the crystalline phase precipitating in LAS glass under heat treatment. We suggested a possible mechanism which include influence of antimony atoms on the residual glass phase providing the observed effect. In order to outline the way to the fabrication of integrated waveguides in zero-CTE media for applications in photonics and integrated optics, the femtosecond laser-induced modification of LAS glass and glass-ceramics depending on the laser pulse energy and the pulse repetition rate was studied. We demonstrated that a series of tightly focused ultrashort laser pulses forms a complicated refractive index variation profile, positive in average, inside studied LAS glass while the laser-induced change of refractive index in LAS glass-ceramics is negative due to partial amorphization in the laser-treated area. This opens an opportunity for direct femtosecond laser writing of depressed-classing waveguides in LAS glass-ceramics. This study was supported by the Russian Science Foundation (grant #19-19-00613).

Keywords: *transparent glass-ceramics, ultra-low expansion, lithium aluminosilicate glass, crystallization, eucryptite, femtosecond laser-induced modification, refractive index*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:10 – 12:30
Hall	NİŞANTAŞI
Chair	SELİM KÜSEFOĞLU

NOVEL ADDITIVE MANUFACTURING TECHNOLOGIES FOR PTRH GLASS FIBRE BUSHINGS

Ian Campbell[1], Markus Brotsack[2], Thilo Becker[3]
[1]*Cooksongold, United Kingdom*
[2]*EOS GmbH, Germany*
[3]*Insitut für Textiltechnik of the RWTH Aachen University, Germany*

While additive manufacturing is by no means a new technology, the technological developments over the last decades have broadened the application range of additive manufacturing significantly. Today, high precision additive manufacturing for precious metals is possible, opening up markets such as the glass fibre industry which have previously been unexplored or unachieved. The technology allows for new design options and new manufacturing infrastructure potential for glass fibre bushings which can lead to significant cost savings as well as performance boosts. The latest experimental and theoretical developments in the field of additive manufacturing of platinum-rhodium glass fibre bushings will be presented.

Keywords: *bushing, additive manufacturing, glass fibre, precious metal, 3d-printing*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:30 – 12:50
Hall	NİŞANTAŞI
Chair	SELİM KÜSEFOĞLU

RECIPES OPTIMIZATION TO IMPROVE FIBER GLASS PRODUCTION

Gülin Demirok, Gülin Demirok, Ateş Gösterişlioğlu, Banu Arslan, Ecem Akırmak, Mustafa Oran, Hande Sesigür
Şişecam Group, Turkey

A wide range of scientific and technical audits has been started and still carried out on the new glass fiber plant of Sisecam after its start-up in the new location. Glass fiber is produced from a fully new design oxyfuel furnace with melting tank, forehearths, bushings and forming units.
Ongoing audits including in-situ observations and data evaluations from the batch to fiber drawing through the bushings show that a number of modifications should be fulfilled to improve the melting conditions, foam formation, thermal and chemical homogeneities and fiber drawing in order to increase the total yield by changing the operational parameters. Two main functional groups have been assigned to find out cause and effect correlations for the entire process. The first group deals with the melting conditions including the raw materials, glass composition as the second one works on fiber drawing parameters including bushing parameters for different fiber products.
This study covers the experimental works as “batch optimisation for producing of fiber glass” for both of achieving better melting conditions inclusively more stable batch pile, foam thickness and thermal structure in the melting tank and also a suitable glass composition to provide better glass formation process. Different batches such as the ones with/without fluorspar, with NaCl, and the batch with different amounts of cullet were investigated by using two different experimental methods. “Batch Free Time” is a conventional method to find out melting rate of a batch at constant temperature with respect to time. The other method so-called “High Temperature Melting Observation System (HTMOS)” is a sophisticated method dedicated to the image processing and detection of evolved gas species during the entire batch melting process with a given time – temperature profile. The experiments carried out by these methods enable to make the comparison of the alternative batch receipts based on the dissolution rate of batches, melting/fining criteria (melting and fining onset temperatures, foam height). Laboratory results will be transferred to the industrial application after the evaluation of two main functional groups.

Keywords: *fiber glass, melting, batch, glass composition*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:00 – 14:30
Hall	NİŞANTAŞI
Chair	ÖZGE AKBULUT

TOWARDS A NEW GENERATION OF GLASS FIBRE PRODUCTS BASED ON REGENERATED FIBRES THERMALLY RECYCLED FROM END-OF-LIFE GRP AND GRP MANUFACTURING WASTE

James L. Thomason (Invited Speaker)
University of Strathclyde, United Kingdom

The recovery and reuse of end-of-life glass fibre reinforced plastics in an environmentally friendly, cost-effective manner is one of the most important challenges facing the composites industry. In 2019 the global consumption of reinforcement grade glass fibre (GF) will likely exceed six million tons. Associated with this global GF consumption is the production of 0.5-1 million tons of GF manufacturing waste much of which is landfilled. Furthermore, approximately 70% of reinforcement GF is used to manufacture thermoset based composites (GRP) which also produces approximately 15% manufacturing waste. Consequently it can be shown that there is actually sufficient GF available in current manufacturing waste together with end-of-life GRP to meet approximately 50% of the global demand for GF reinforcements. However, such GF and GRP materials (both end-of-life and manufacturing waste) are difficult to recycle in an efficient manner and have historically also been disposed of in landfills. Such landfilling is rapidly becoming untenable due to legislative and landfill pricing developments.

A number of processes for recycling GRP are available or under development. However, nearly all options deliver recycled glass fibres (RGF) which are not cost-performance competitive due to the huge drop in performance of RGF compared to its original state. A breakthrough in the regeneration of RGF performance has the potential to totally transform the economics of recycling GRP waste and end-of-life composites. The Advanced Composite Group at the University of Strathclyde has been working on this challenge for over a decade. This presentation will review the status of the ReCoVeR project which is focussed on enabling cost-effective regeneration of the performance and value of glass fibres obtained from thermal recycling of end-of-life GRP and GRP manufacturing waste. Highlights of our latest results will be presented with emphasis on our breakthrough treatments to regenerate the properties of thermally recycled glass fibres and their reuse as a composite reinforcement.

Coauthors
L. Yang, Department of Mechanical and Aerospace Engineering, University of Strathclyde

Keywords: *Glass fibre reinforced plastics, Composites, Recycled glass fibres (RGF), End-of-life composites*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:30 – 15:00
Hall	NİŞANTAŞI
Chair	ÖZGE AKBULUT

MEASUREMENT OF INTERFACIAL ADHESION IN COMPOSITES BY THE SINGLE FIBER FRAGMENTATION METHOD

Selim Küsefoğlu (Invited Speaker)
Boğaziçi University and Şişecam Group, Turkey

Creating high adhesion forces between the fiber and the matrix is essential for successful composites. Numerous additives –called coupling agents- are available for increasing the adhesion of glass fiber to the matrix polymer using intermolecular attractive forces, ionic forces or chemical bonds. Traditionally the only quantitative measurements available are the mechanical properties of the finished part such as tensile strength and flexural strength. Such tests are engineering tests and they produce results that depend on the sample preparation methods. Recently tests that are done on a single fiber and use fundamental principles have appeared. These tests make it possible to measure interfacial adhesive force directly and with high precision.
In this presentation a review of the different single fiber methods for the measurement of interfacial adhesive force will be given. Our experience with the single fiber fragmentation test will be described.

Coauthors
Banu Taşlıca, Boğaziçi University, İstanbul, Turkey

Keywords: *composites, interfacial strength, single fiber fragmentation*

Session	Composites, Bioglasses, Cellular and Granular Matter
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 15:20
Hall	NİŞANTAŞI
Chair	ÖZGE AKBULUT

EVOLUTION OF GLASS FIBER PRODUCTS IN ŞIŞECAM

Aref Cevahir, Sultan Telli
Şişecam Group, Turkey

Starting from 1976 Şişecam elyaf San A.Ş. subsidiary of Şişecam has been producing glass fiber products for reinforcing polymeric materials. At the beginning, powder bonded mat and gun roving products were manufactured. At the same time, Şişecam Elyaf produced composites and introduced these into domestic market in order to contribute to grow up the interest to the composite culture within the country. The increase in both the production and consumption of glass fiber reinforced composites in the world, Şişecam elyaf expanded its annual production capacity and also diversified its products to be able to compete with the leading glass fiber producers in either domestic or global (especially European) markets. Chopable roving for SMC and direct roving for pipe manufacturing were among some of those new products. Wide usage of glass fiber reinforced composites in the automotive, household, construction, wind turbine and infrastructure industries leaded to big competition between glass fiber manufacturers to produce products with higher performance and lower price. Utilizing glass fiber reinforced composites in the automobiles instead of steel and other metal alloys resulted big save in money since the weight of the cars were reduced enormously and consequently fuel consumption reduced globally. Şişecam elyaf produces almost all type of glass fiber products using E-glass and make service to most of the customers in the market. In the new manufacturing facility in Balıkesir Şişecam Elyaf utilizes advanced technologies and robotics to increase the quality of the products and productivity of the manufacturing line, also satisfying customer demands.
By understanding the relationship between the glass fiber products and different composite matrices, Şişecam elyaf is now concentrated on new projects to produce direct rovings with higher mechanical properties and glass fibers with higher young's modulus.

Keywords: *glass fiber, composite, sizing, smc (sheet molding compound), direct roving, wind turbine, e-glass*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

GLASS CHEMISTRY AND STRUCTURE

ŞİŞECAM

www.glassconference-sisecam.com

Session	Glass Chemistry and Structure
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:50 – 16:20
Hall	NİŞANTAŞI
Chair	JAMES L. THOMASON

WASTE NOT WANT NOT – DECARBONISATION AND WASTE UTILISATION

Nicholas Kirk (Invited Speaker)
Glass Technology Services Ltd, United Kingdom

The glass industry is heading for decarbonisation, which is being driven by the desire of glass manufacturers, consumers and governments to have a more sustainable future for manufacturing and to halt global warning. The glass industry has been working together to identify new technologies and practices that will reduce carbon emissions and environmental impact. Glass Technology Services has been supporting the UK Decarbonisation Action Plan by investigating the use of alternative raw materials from industrial waste materials, lower melting point glass compositions, bio-fuels, hydrogen combustion, glass recycling from end of life buildings, pelletisation of raw materials to name a few. This presentation will present the option of utilising waste materials from bio-mass energy production and how this waste can be processed and incorporated into soda-lime-silica glass production. It has been demonstrated that the use of this waste material can provide:

• valuable glass making oxides such NaO, K2O, CaO, SiO2
• evolution of less CO2 from the melting reaction as less carbonate materials are required
• vitreous form which lowers the meting temperature and increases the rate of the melting reaction

These benefits lead to improved glass quality and lower CO2 from both the combustion process and raw materials. It has already been demonstrated that this waste can be used, and the results of the initial trials and the next steps will be shared.

Coauthors
Robert Ireson, Martyn Marshall, Chris Holcroft

Keywords: *decarbonisation, low melting temperature glass, bio fuels, hydrogen combustion, pelletisation, end of life buildings*

Session	Glass Chemistry and Structure
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:20 – 16:40
Hall	NİŞANTAŞI
Chair	JAMES L. THOMASON

GLASSES BASED ON ANTIMONY OXIDE FOR LIGHT AMPLIFICATION

Mohamed Toufik Soltani[1], Dominique De Ligny[2]
[1]*Mohamed Khider Biskra, Algeria*
[2]*Institute of Glass and Ceramics Department of Materials Science and Engineering Martensstr. Germany*

Until today, conventional glass formers such as SiO2, B2O3, GeO2 or P2O5 have been preferred in opto-electronic applications. However, due to their limited infrared transmission, optical losses and low solubility of rare-earth ions in glass network, considerable attention has been focused on the investigation of new glass types which demonstrate some better optical properties. In this respect, heavy metal oxide and chalcogenide glasses have attracted much attention for new generation opto-electronic applications due to their broad transparency from visible to infrared region, high solubility of rare-earth ions and good non-linear optical properties. Recently, antimony oxide-based glasses have emerged as one major family of heavy metal oxide glasses and appeared promising for potential applications in non-linear optical devices like ultra-fast optical switches and power limiters. They also have potential for broad band optical amplifiers operating around 1.5 mm as antimony-silicate glass fibers and in the field of optical amplification in telecommunication C-band (1530–1560 nm), light generation and other applications.

Keywords: *Sb2O3-Emission-IR-Raman*

Session	Glass Chemistry and Structure
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:40 – 17:00
Hall	NİŞANTAŞI
Chair	JAMES L. THOMASON

REDUCING ANTIMONY TRIOXIDE AND SODIUM NITRATE CONSUMPTION IN LOW IRON FIGURED GLASS PRODUCTION

Bahri Erdoğan
Şişecam Group, Turkey

In figured glass production for solar panels the iron content and Fe+2/ Total Iron ratio are preferably reduced to a minimum level for maximizing solar transmission performance. In this way, Fe+2 and Fe+3 induced absorption losses are minimized. Two basic tools are available for maintaining process stability in low iron glass production. The first one is the batch control of iron entry. Another important tool is altering of iron oxidation states. The latter is necessary because despite the careful selection of qualified raw materials and separator precautions, some unwanted iron species seep into the furnace. Through the oxidation of Fe+2 to Fe+3; the near infrared absorption is shifted into a narrow band in the ultraviolet area, resulting in less solar transmission loss. For this purpose, carbon is extracted from the batch composition, air/fuel ratios are increased and high glass temperatures are avoided. However, the most effective method for increasing oxygen partial pressure and oxidation of iron is the use of antimony trioxide (Sb2O3), an oxidant batch component. Sb2O3 is oxidized at low temperature with sodium nitrate (NaNO3) to Sb2O5. The presence of alkali and high temperature Sb2O5 is reduced to a trivalent Sb2O3 and oxidize Fe+2 to Fe+3.

In this study a comprehensive experimental design is presented for reducing the consumption of Sb2O3 and NaNO3, which are necessitated by high raw material prices and pressing market expectations for lower glass production costs. Our results pertain to the set of experiments from a single production campaign on a 300t/day capacity figured glass production line. The regression analysis successfully ties solar performance to process parameters. Additionally, Poisson regression analyzes are reported for the control of bubble defect. According to the determined relationships, Sb2O3 consumption is shown to be reduced by 60% and NaNO3 consumption is shown to be reduced by 80%. Such reductions are achieved without impairing solar transmission performance yet keeping the occurrence of bubble defects within the current specification limits.

Keywords: *figured glass, glasses for solar panels, glass chemical composition, batch materials, antimony trioxide, sodium nitrate*

Session	Glass Chemistry and Structure
Date	NOVEMBER 21, 2019, THURSDAY
Time	17:00 – 17:20
Hall	NİŞANTAŞI
Chair	JAMES L. THOMASON

INVESTIGATION OF WHITE LIGHT GENERATION IN RARE EARTH DOPED TELLURITE GLASS NANOCOMPOSITES FOR SOLID STATE LIGHTING

Naji Vahedigharehchopogh, Orhan Kıbrıslı, Miray Çelikbilek Ersundu, Ali Ersundu
Yıldız Technical University, Turkey

Nowadays, commercially available white LEDs are generally fabricated by coating a blue LED chip with a suitable yellow phosphor using epoxy resin. The epoxy resin degrades after long-term irradiation of blue LED chip. This degradation leads to a decrement in luminous flux of white LEDs. Essentially, thermal instability of epoxy resin and large refractive index difference between epoxy and phosphor material causing scattering losses are two major drawbacks of conventional white LEDs. Therefore, numerous studies have been recently accomplished on rare earth (RE) ions doped glass nanocomposites in order to replace phosphor and epoxy-based LED systems to overcome above mentioned problems. Among different glass matrices, tellurite glasses have drawn attention due to their favorable properties such as high chemical and thermal stability, high RE solubility, high refractive index, and low phonon energy. In this work Ho3+, Tm3+ and Yb3+ ions were doped in a tellurite glass matrix together with compound semiconductor nanoparticles in order to investigate thermal, optical, luminescence and color properties of obtained tellurite glass nanocomposites. Thereupon, glass nanocomposites were synthesized by conventional melt-quenching technique and subsequent heat-treatment. Thermal properties were investigated using DSC technique. Absorbance spectra were recorded using UV-Vis-NIR spectroscopy. Luminescence spectra and lifetime measurements were realized using spectrofluorometer. Evaluation of obtained preliminary colorimetric results revealed that RE ions doped tellurite glass nanocomposites have great potential to be used for white light illumination in solid state lighting technology.
The authors acknowledge The Scientific & Technological Research Council of Turkey (TUBITAK) and Yildiz Technical University Scientific Research Fund for their financial support under the projects numbered 117M206 and FYL-2019-3585, respectively.

Keywords: *white light, solid state lighting, photoluminescence, tellurite glass, nanocomposite*

Session	Glass Chemistry and Structure
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:00 – 14:30
Hall	EMIRGAN
Chair	EBRU MENŞUR ALKOY

SILICATES GLASSES ACTIVATED RRE-IONS AS A PROMISING MATERIAL FOR LUMINESCENCE APPLICATIONS

Ekaterina Trusova (Invited Speaker)
Belarusian State Technological University, Belarus

Among a variety of inorganic luminescence materials, silicates are prospective to construct new phosphors. They find numerous applications as luminescent materials in a crystalline phase. However, in a glass and glass-ceramics form, silicates possess several advantages. Unlike single crystals, glasses can be obtained in a wide range of compositions, which in turn can correspond to stoichiometric crystalline compounds. Besides, glasses are environmental friendliness, low production cost, mechanical resistance, the relative ease of obtaining large volumes of samples and fibers, as well as the ease of molding and processing of final products. The samples of the silicate glasses and glass-ceramics based on stoichiometric compounds with the composition ((M2O)MO-2SiO2, where M= Li, Ca, Sr, Ba) and doped with different combinations RRE-ions were obtained in present work. Synthesis conditions (glass transition temperature), crystallization ability and luminescence properties of obtained glasses depend on the composition. It was established their potential application as wavelength shifters for transforming the UV light into eye visible and as perspective light converters for white light LEDs. Moreover, it was shown to obtaining glass fibers from these materials that allow more effective applications in optoelectronics with complex geometries.

Keywords: *glass, glass ceramics, luminescence*

Session	Glass Chemistry and Structure
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:30 – 14:50
Hall	EMIRGAN
Chair	EBRU MENŞUR ALKOY

DEVELOPMENT AND CHARACTERISATION OF MICRONIZED FRIT TO ACHIEVE GLASS-CERAMIC ENAMELS DERIVED FROM THE LI2O-NA2O-AL2O3-TIO2-SIO2 SYSTEM

Seçil Aydın[1], Oğuzhan Çimen[1], Buğra Çiçek[2,3]
[1]Gizem Frit Research and Development Center, Turkey
[2]Department of Metallurgical and Materials Engineering, Yıldız Technical University, Turkey
[3]Boron Based Materials and Advanced Chemicals Research and Application Center, Koç University, Turkey

Pad printing is one of the oldest printing techniques that has undergone a rapid development in the past years. Thanks to the use of flexible silicon rubber was instrumental enables printing not only on flat, but on curved or other non-flat surfaces. It is a well-known fact that, by virtue of total transfer pad printing, the time and cost of glassware production can be kept under expected levels with containable production.
The present study represents, development and characterization of micronized glass enamel Li2O-Na2O-AL2O3-TiO2-SiO2 system being composed, in percent weight on a calculated oxide basis, of SiO2: 38 to 50%, B2O3: 15 to 25%, ZnO: 5 to 12%, Al2O3: 6 to 11%, Li2O + Na2O + K2O: 5 to 10 % free of heavy metals determined by means of X-ray Fluprescence (XRF) instrument. Glass enamel has a low softening and melting point with a low thermal expansion coefficient having an adherent to substrate demonstrating chemical and mechanical resistance with a particularly high gloss.
The samples were prepared by varying thermal treatment conditions in order to determine the formation of different crystal phases having effect on the properties of glass enamel through the characterization of differential thermal analysis and X-Ray diffraction analysis.

Keywords: *glass-ceramic; glass enamel; crystal structure; XRD*

Session	Glass Chemistry and Structure
Date	NOVEMBER 22, 2019, FRIDAY
Time	14:50 – 15:10
Hall	EMIRGAN
Chair	EBRU MENŞUR ALKOY

DYSPROSIUM AND SILVER NANOPARTICLES DOPED BORATE GLASSES

Deniz Koçyiğit, Melis Gökçe, Atılay Güngör, Aytaç Gökçe
Aydın Adnan Menderes Üniversitesi, Turkey

The dysprosium doped borate glasses containing silver nanoparticles have been synthesized by conventional melt quenching method. The structural, optical and luminescence properties of glass samples were investigated with XRD, TEM, absorption and photoluminescence measurements. The XRD pattern indicates the amorphous nature of network structure. The presence of silver nanoparticles and average nanoparticle diameter were determined from the TEM analysis. The absorption spectra display eleven absorption bands belonging to the transitions of Dy3+ ion from the ground state to the different excited states. The surface plasmon band of silver nanoparticles was observed at 511 nm. From the emission spectra the blue, yellow and red emission bands centered at 480, 572, 660 and 750 nm. The strongest emission has been observed from the 4F9/2↑6H13/2 level of Dy3+ ions in borate glasses. With increasing silver doping level, the emission and excitation intensities increase and then these intensities decrease due to concentration quenching. The CIE chromaticity coordinates (x,y) and correlated color temperatures (CCT) values were determined from the photoluminescence spectra. It was found that the (x, y) and CCT values of studied glasses may give cool white light emission under UV excitation. The results indicate that silver and dysprosium doped borate glasses are promising materials for solid state lighting applications.

Keywords: *borate glass, nanoparticle, rare earth, luminescence, WLED*

Session	Glass Chemistry and Structure
Date	NOVEMBER 22, 2019, FRIDAY
Time	15:10 – 15:30
Hall	EMİRGAN
Chair	EBRU MENŞUR ALKOY

FABRICATION, STRUCTURE AND LUMINESCENT STUDY OF RARE-EARTH-CO-DOPED SOL-GEL SILICA GLASSES

Iryna Sulym[1], P. Veteška[2], A. Gatial[2], R. Klement[3], M. Borysenko[1], M. Janek[2,4], D. Sternik[5], A. Derylo-Marczewska[5]
[1]Chuiko Institute of Surface Chemistry of NAS of Ukraine, Kyiv, Ukraine
[2]Faculty of Chemical and Food Technology, Slovak University of Technology, Bratislava, Slovak Republic
[3]FunGlass - Centre for Functional and Surface Functionalized Glass, TnUAD, Trenčín, Slovak Republic
[4]Faculty of Natural Sciences, Comenius University, Bratislava, Slovak Republic
[5]Faculty of Chemistry, Maria Curie-Skłodowska University, Lublin, Poland

Silica glasses are commonly used as optical materials in a broad range of applications due to their ready availability, relatively simple fabrication and large panel of properties. Their luminescent properties are usually modulated by doping with rare-earth ions. Moreover, rare-earth ion-doped sol-gel silica glasses are considered promising materials for photonics applications such as lasers, photonics or fiber optics. In current study, the transparent erbium and ytterbium co-doped SiO2-based glasses having pink-colored hue were obtained using a new variant of the sol-gel synthesis method. Produced Er3+/Yb3+ co-doped silica glasses (0.25 – 5 wt. Er2O3 and 2 wt. % Yb2O3) have a high optical homogeneity and contains OH groups in amount of 0.4 – 1 wt. %. The UV–VIS absorption spectroscopy indicated highest absorption intensity at 976 nm, corresponding to the combination of erbium with ytterbium in the absorbance spectra of the studied glasses. The photoluminescence intensity of the prepared glasses was dependent on the Er3+/Yb3+ ratios in the samples. The highest enhancement of green emission at 556 nm was found for the sample with highest erbium oxide concentration (5 wt. %). All studied Er3+/Yb3+ doped silica glass samples exhibit similar double-exponential decay behavior with the short decay component of ~17 ms and long decay component of ~217 ms, respectively.
Acknowledgement. The authors acknowledge financial support by the NSP of the Slovak Republic supporting the study stay of Dr. I. Sulym (No 19862) at the Faculty of Chemical and Food Technology, SUT. The financial support of the Slovak Grant Agency for Science VEGA No. 1/0906/17, 1/0527/18 and the Visegrad Fund (No 51910525) are greatly appreciated.

Keywords: *sol-gel glasses, rare-earths ions, photoluminescence, optical absorbtion, FTIR spectra*

Glass in the Sustainable Future
ACHIEVING WHAT IS POSSIBLE...

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

SURFACES-INTERFACES AND ADVANCED GLASS PROCESSING

ŞİŞECAM

www.glassconference-sisecam.com

www.glassconference-sisecam.com | November 21-22, 2019 | İstanbul

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:00 – 14:30
Hall	SAMATYA
Chair	GÜLDEM KARTAL ŞİRELİ

CHEMICAL STRENGTHENING OF SILICATE GLASS: PROCESSING ISSUES AND INNOVATIONS

Vincenzo M. Sglavo (Invited Speaker)
University of Trento, Italy

Ion-exchange process has gained remarkable interest during the last years for chemical strengthening silicate glasses because of its suitability and flexibility in the reinforcement of components with different geometry and thickness. During a typical industrial process, sodium atoms contained in the glass are substituted by potassium ions diffusing from molten potassium nitrate at temperatures below the strain point of the glass, thus creating a bi-axial residual compressive stress in the material surface which strengthens the component.
After a brief analysis of the ion exchange process fundamentals, two main aspects regarding processing issues and innovative procedures are discussed.
At first, an interesting aspect regarding the presence of impurities in the bath, introduced with the raw salt or accumulated during the process and responsible for the resulting performance is pointed out. Analyses of commercial soda lime silicate float glass and sodium borosilicate glass are reported and the effect of variable sodium, magnesium and calcium concentration in the molten bath on the efficiency of the ion exchange process is analyzed. The performances of chemically strengthened samples in terms of potassium penetration profile, residual stress and mechanical strength are studied. The addition of limited quantities of silica is also advanced as possible remedial action for non-efficient salts.
Then, an innovative process where an electric field – assisted ion exchange is carried out to enhance sodium-potassium interdiffusion and improve the mechanical performances of soda-lime-silicate and soda-borosilicate glass is presented. Electric fields with variable intensity are applied cyclically in both direct and inverted polarization. Mechanical tests are used to characterize the performances of the strengthened material. Spectroscopic analyses are also carried out to determine the potassium concentration in the surface layers of the samples. It is shown that the application of the electrical field allows to enhance Na-K interdiffusion to a large extent, thus reducing the treatment time well below the hour. The cyclic process allows to reinforce both surfaces thus allowing to reach very high mechanical strength.

Keywords: *chemical strengthening, strengthened glass, ion exchange, electric field-assisted ion exchange, residual stress*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:50 – 15:10
Hall	SAMATYA
Chair	GÜLDEM KARTAL ŞİRELİ

INVESTIGATION OF CRACK FORMATION IN CHEMICALLY STRENGTHENED GLASS BY ACOUSTIC EMISSION TECHNIQUE

Ezgi Deniz Kaçar[1], Lukas Šimurka[1], Lukas Václavek[2], Jan Tomáštík[2], İlkay Sökmen[1], Radim Čtvrtlík[2]
[1]Şişecam Group, Turkey
[2]Palacky University in Olomouc and Institute of Physics Academy of Sciences of the Czech Republic, Joint Laboratory of Optics, Czech Republic

Ion-exchange process has gained remarkable interest during the last years for chemical strengthening silicate glasses because of its suitability and flexibility in the reinforcement of components with different geometry and thickness. During a typical industrial process, sodium atoms contained in the glass are substituted by potassium ions diffusing from molten potassium nitrate at temperatures below the strain point of the glass, thus creating a bi-axial residual compressive stress in the material surface which strengthens the component.
After a brief analysis of the ion exchange process fundamentals, two main aspects regarding processing issues and innovative procedures are discussed.
At first, an interesting aspect regarding the presence of impurities in the bath, introduced with the raw salt or accumulated during the process and responsible for the resulting performance is pointed out. Analyses of commercial soda lime silicate float glass and sodium borosilicate glass are reported and the effect of variable sodium, magnesium and calcium concentration in the molten bath on the efficiency of the ion exchange process is analyzed. The performances of chemically strengthened samples in terms of potassium penetration profile, residual stress and mechanical strength are studied. The addition of limited quantities of silica is also advanced as possible remedial action for non-efficient salts.
Then, an innovative process where an electric field – assisted ion exchange is carried out to enhance sodium-potassium interdiffusion and improve the mechanical performances of soda-lime-silicate and soda-borosilicate glass is presented. Electric fields with variable intensity are applied cyclically in both direct and inverted polarization. Mechanical tests are used to characterize the performances of the strengthened material. Spectroscopic analyses are also carried out to determine the potassium concentration in the surface layers of the samples. It is shown that the application of the electrical field allows to enhance Na-K interdiffusion to a large extent, thus reducing the treatment time well below the hour. The cyclic process allows to reinforce both surfaces thus allowing to reach very high mechanical strength.

Keywords: *chemical strengthening, strengthened glass, ion exchange, electric field-assisted ion exchange, residual stress*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	14:30 – 14:50
Hall	SAMATYA
Chair	GÜLDEM KARTAL ŞİRELİ

EFFECT OF CHEMICAL TOUGHENING ON THE LATERAL HARDNESS AND SCRATCH RESISTANCE OF SODALIME SILICATE AND ALUMINOSILICATE GLASSES

Gohar Sani, Lothar Wondraczek
Friedrich Schiller University of Jena, Germany

Normal indentation is widely utilized to correlate the defect resistance with composition and structure of glasses which lead to the creation of damage resistant glasses. However, micro-indentation depths normally represent the ideal state and does not simulate the real-world service conditions where the damage is less severe i.e. scratch. Furthermore, the contribution of lateral loading component which is always involved to the surface damage of glass through scratching is less explored. To this end, we quantitatively analyse the scratch hardness of sodalime and aluminosilicate chemically toughened glasses. Chemically toughened glasses were annealed resulting in surface compressive stress removal to study the influence of surface compressive stress on scratching behaviour. Corresponding potassium glass compositions of the as-received aluminosilicate and sodalime silicate glasses having varying potassium content (0% K, 50% K, 100% K) were melted to study the effect of compositional change incurred due to the ion-exchange process. It has been found that the surface compressive stress has a greater effect on the scratching property as compared to the compositional change caused by the chemical toughening process. Surface compressive stress increases the resistance against scratch-induced material abrasion and counteracts the indenter penetration into the surface and material removal. The resistance of the material to lateral deformation is related to the stiffness and the free volume available for structural displacement. The effect of stress and high structural density and rigidity results in higher scratch hardness (Hs) in chemically toughened glasses. Increase in Hs results from the high values of mean-free energy density and of cohesion factor (F). There is a complex relationship between the effects of ploughing, friction and pile-up on Hs during lateral loading as compared to normal loading between the studied glasses.

Keywords: *chemical toughening, scratch hardness, mechanical characterization*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:10 – 15:30
Hall	SAMATYA
Chair	GÜLDEM KARTAL ŞİRELİ

ULTRA STRONG SHEET GLASS THROUGH SUPER-EFFICIENT SIDE-SELECTIVE ION EXCHANGE

Nahide Özben[1], Bengü Güldalı[2], Semin Atılgan[1], Ahmet Burak Okan[1], Duygu Güldiren[1], Yusuf Öztürk[3], Esin Günay[3], İlkay Sökmen[1], Lothar Wondraczek[4]
[1]Şişecam Group, Turkey
[2]Department of Materials Science and Engineering, Gebze Technical University, Turkey
[3]Tübitak, Marmara Research Center, Materials Institute, Turkey
[4]Otto Schott Institute of Materials Research, Friedrich Schiller University, Germany
[5]JSJ Jodeit GmbH, Germany

When the conventional chemical tempered process via bath technology, which is based on immersing the glass sheets in molten salts, is applied to float glasses, the difference in surface composition between tin-side and atmosphere-side results in different potassium diffusion behavior and, hence, different compressive stress layer of the two glass sides. Especially with thin float glasses this causes unwanted bending and creates a waviness of the final product. In order to overcome this obstacle, side-selective application of salt media on float glass, which is based on spray coating has been studied. The composition of the salt media for each side of float glass was developed and adapted to realize equalized stress profiles on both glass sides and to yield high total glass strength, which is benchmarked with the traditional chemical tempering technique of immersing the glass into molten salt baths.

Keywords: *chemical tempering, ion exchange, bath technique, spray technique, soda lime silicate glass*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:50: - 16:20
Hall	SAMATYA
Chair	VINCENZO M. SGLAVO

NEW GREEN TECHNOLOGY FOR BORON DIFFUSION APPLICATIONS INTO DIFFERENT SUBSTRATES

Güldem Kartal Şireli (Invited Speaker)
Istanbul Technical University, Turkey

Hard and corrosion-resistant surfaces on engineering components have been increasingly requested to have longer service life along with better performance. Transition metal borides, an important class of advanced structural ceramic materials, are the perfect candidate for various applications due to their extraordinary characteristic properties; such as high melting points and extreme hardness, good wear and corrosion resistance as well as excellent thermal and electrical properties.
Borides are the binary or higher solid compounds of boron and metal. Most of the borides were synthesized by Moissan in early 1900s. Despite this earlier discovery, borides haven't found in modern technology as many as carbides or nitrides.
The main reason of this less attention of borides is due to their long, costly and challenging manufacturing processes. Instead of following common long procedure, metal boride can be grown on any conductive substrates in a fast and more importantly simply as well as environmentally friendly way.
With our developed coating techniques, the metal boride can be grown by diffusing boron atoms into the surface of substrate materials via CRTD-Bor (cathodic reduction and thermal diffusion boriding) or can be formed as a coating by co-reduction of both metal and boron form the electrolyte. The novel part of these techniques is to the utilization of simple oxide-based chemicals; hence many technical issues was eliminated such as the usage of expensive chemicals and the necessity of long process durations and the generation of huge amounts of solid wastes and gaseous emissions. By playing process parameters, the desired composition of boride phase is possible to be grown on any substrates such as steels including high alloy steels, nickel based alloys and titanium and its alloys, etc. This techniques is minimum 6 times faster and there is no environmental issues as experienced in conventional industrial processes.

Coauthors
Servet Timur, Istanbul Technical University, Turkey

Keywords: *Metal Borides, boriding, CRTD-Bor, surface modification*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:20 – 16:40
Hall	SAMATYA
Chair	VINCENZO M. SGLAVO

ACID AND ALKALI RESISTANCE OF CHEMICAL TEMPERED GLASSES: INFLUENCE OF CONTAMINATION IN SALT BATH

Bengü Güldalı[1], Nahide Özben[2], Semin Atılgan[2], İlkay Sökmen[2]
[1]*Gebze Technical University, Turkey*
[2]*Şişecam Group, Turkey*

As the thickness of float glass decreases especially below 2 mm, the mechanical strength of the glass diminishes considerably. Therefore, there is extensive amount of research and development studies in the field of strengthening of thin glass. The most common technique is chemical tempering process. During chemical tempering process, a compression layer is formed on the glass surface via ion exchange reaction in a molten salt medium. In addition to the increase in mechanical strength, chemically tempered glasses are required to have a high chemical resistance according to the purpose of use. Investigations of glass resistance against acid and alkali reagents is of vital importance for the determination of its lifetime and reliability for various applications. In this study, flat glasses with alumina silicate and two different soda lime silicate glass compositions were strengthened by chemical tempering process in clean and contaminated molten salts and then acid and alkali resistance of the chemically tempered glasses were compared based on DIN 12116 and ISO 695 standards, respectively. Elemental contents of clean and contaminated salts were analyzed by inductively coupled plasma - optical emission spectrometry (ICP-OES) before chemical tempering process. Size, weight, compressive stress and depth of layer measurements of chemically tempered glasses were performed before and after chemical resistance test were measured. As a result of the calculations, the glass samples were classified according to the limit values given in the standards for acid and alkali resistance tests. The results of these experiments prove that chemical tempering quality of the glass is highly affected by the degree of contamination in tempering salt. As the amount impurities in tempering salt increases, chemically tempered glass surface gets more prone to get corroded within the course of time, which is approved by the chemical resistance experiments.

Keywords: *chemical tempering, ion exchange, thin flat glass, contaminated salt, clean salt, acid resistance, alkali resistance*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	16:40 – 17:00
Hall	SAMATYA
Chair	VINCENZO M. SGLAVO

THE EFFECT OF DIFFERENT CALCIUM COMPOUNDS ON BATH CONTAMINATION IN CHEMICAL STRENGTHENING PROCESS

Aslı Çalı[1], Büşra Demir[1,2], Nahide Özben[1], Semin Atılgan[1], Ali Erçin Ersundu[2], Miray Çelikbilek Ersundu[2], İlkay Sökmen[1]
[1]Şişecam Group, Turkey
[2]Yıldız Technical University, Turkey

Although there are many methods to improve the strength of glass, the most preferred method in industrial applications for thin glasses is chemical tempering. Chemical tempering method offers several advantageous properties such as, applicability to thin and complex shaped glasses and providing higher compressive stress values compared to other alternatives. However, there are important parameters to be considered during the chemical tempering process. One of the key parameters that should be considered is bath contamination. Therefore, in this study we aim to investigate the effect of bath contamination through different forms of calcium compounds on chemical strengthening efficiency. In the experimental studies, 1.1 mm soda-lime silicate glasses were washed with distilled water and alcohol, respectively and then subjected to chemical tempering at 450°C for 4 h. The experimental studies were carried out using different salt baths having various amounts of contaminants i.e. Ca(NO3)2, CaHCO3, CaCO2, CaO. The compressive stress and depth of layer values were measured using FSM 6000LE surface stress meter to understand the chemical tempering efficiency. Fourier Transform Infrared Spectroscopy (FTIR) analysis was realized to evaluate the changes in bond structure and to investigate the corrosion behavior. Haze and transmittance tests were performed under visible light to examine the optical properties. Methylene blue and tartaric acid tests were used to determine stain formation and coloration, respectively. In addition, aging tests were applied to all samples for 14 days at 50°C and under 95% relative humidity to investigate the resistance of glasses to atmospheric humidity conditions. Following to aging testes, all characterizations were repeated, and the obtained results were compared with the results of pre-aged samples. In addition, pH and alkalinity tests were applied to the salt baths. The primary results show that the Ca addition, even in small amounts, has negative effect on the chemical tempering efficiency.

Keywords: *chemical strengthening, salt bath, contamination, calcium compounds*

Session	Surfaces-Interfaces and Advanced Glass Processing
Date	NOVEMBER 21, 2019, THURSDAY
Time	17:00 – 17:20
Hall	SAMATYA
Chair	VINCENZO M. SGLAVO

THE EFFECT OF BATH CONTAMINATION ON CHEMICAL STRENGTHENING VIA DIFFERENT FORMS OF SODIUM COMPOUNDS

Büşra Demir[1], Aslı Çalı[1,2], Nahide Özben[1], Semin Atılgan[1], Ali Erçin Ersundu[2], Miray Çelikbilek Ersundu[2], İlkay Sökmen[1]
[1]Şişecam Group, Turkey
[2]Yıldız Technical University, Turkey

Chemical tempering is a glass strengthening method by replacing sodium ions in glass structure with larger potassium ions in the molten salt bath. This method is more often used on thin glasses to provide desired high strength/weight ratio that is expected by current glass industry. There are several parameters affecting the chemical tempering process such as, glass composition, process temperature, process time, salt bath composition, bath impurities. All these parameters should be taken into consideration in order to achieve a successful and highly efficient glass strengthening. Therefore, the ultimate goal of this work is to investigate the effect of bath contamination on chemical strengthening efficiency through different forms of sodium compounds. In the experimental studies, soda-lime silicate glasses having a thickness of 1.1 mm were thoroughly washed with distilled water and alcohol and subsequently subjected to chemical tempering at 450°C for 4 h. During chemical tempering process, different salt baths containing various amounts of contaminants i.e. NaNO3, NaHCO3, Na2CO3 and Na2O were used. Compressive stress and depth of layer measurements were realized using FSM 6000LE surface stress meter to understand the chemical tempering efficiency. Fourier Transform Infrared Spectroscopy (FTIR) analysis was conducted to evaluate the changes in bond structure and to investigate the corrosion behavior. Haze and transmittance tests were performed under visible light to examine the optical properties. Methylene blue and tartaric acid tests were used to determine stain formation and coloration, respectively. Furthermore, samples were aged for 14 days at 50°C and under 95% relative humidity to investigate the resistance of glasses to atmospheric humidity conditions. After aging, all tests were repeated, and the obtained results were compared with results of pre-aged samples. Besides, pH and alkalinity tests were applied to the salt baths. The preliminary results show that the increasing amount of salt bath contamination by NaHCO3 and Na2CO3 causes an increase in pH value which ultimately results glass corrosion, however this contamination also increases the surface compression properties. On the contrary, increasing amount of NaNO3 in bath composition yields a reduction in compressive stress values. The first findings indicate that the salt bath contamination should be monitored regularly in order to fully control the chemical tempering process.

Keywords: *chemical strengthening, salt bath, contamination, sodiumcompounds, aging*

Glass in the Sustainable Future
ACHIEVING WHAT IS POSSIBLE...

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

PRODUCT DESIGN

ŞİŞECAM

www.glassconference-sisecam.com

www.glassconference-sisecam.com | November 21-22, 2019 | İstanbul

Session	Product Design
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:20 – 11:50
Hall	SAMATYA
Chair	CEMİL TOKEL

FINNISH GLASS DESIGN HERITAGE AS AN INSPIRATION ON NEW DESIGN WORKS

Mikko Laakkonen (Invited Speaker)
Designer, Studio Laakkonen, Finland

High quality design plays a key role in the making of sustainable products. And this role will grow in the future. Finland have great heritage on glass design sector. Many of those design from past decades had to survive in the teeth of time. As a designer, how I can design new products which survive and be part people in everyday life. Can I use know-how that is inside on those objects from the past and still creating new. I believe good design starts from function and also have own individual character. I dry my best to design long lasting products which are functional, beautiful and understandable.

Keywords: *sustainable products, glass design, functional products*

Session	Product Design
Date	NOVEMBER 21, 2019, THURSDAY
Time	11:50 – 12:10
Hall	SAMATYA
Chair	CEMİL TOKEL

GLOBAL GLASS TRENDS

Jorma Vitkala
Glaston Finland OY, Finland

Global Glass Trends The world of glass is evolving ever more quickly with spectacular new architectural elements, smart glass, transparent energy-generating solutions and other multifaceted glass applications considered impossible only a few years ago. This not-to-miss presentation gives an all-encompassing overview of the glass business and trends today and where it is going in the near future. It showcases some of the latest development in technology and exciting new products coming soon to the market. Plus, it covers the most influential market drivers that are important to know and how they affect the different players throughout the entire glass industry value chain. Highlights from the various perspectives, research results and product development and introductions at GPD 2019 will be used as the basis for this presentation. This provides the audience with a condensed summary of the main takeaways from the entire four-day world-class conference with its 242 presentations and workshops. It offers a wealth of information and insights for how to become part of the latest developments in glass.

Keywords: *glass business, glass trends, gpd*

Session	Product Design
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:10 – 12:30
Hall	SAMATYA
Chair	CEMİL TOKEL

STRATEGIES FOR SUSTAINABILITY IN THE DESIGN OF TURKISH TEA GLASSES: AN EDUCATIONAL PROJECT IN COLLABORATION WITH INDUSTRY

Naz A.G.Z. Börekçi, Fatma Korkut
Middle East Technical University, Turkey

This paper describes the design process of a tea set (tea glass, saucer, sugar bowl) carried out as an industrial design studio project in collaboration with a Turkish glass manufacturer in 2016-2017, with 27 third-year undergraduate industrial design students in a Turkish University. Regarding the augmented usage of throw-away single-use paper or plastic cups, it was found necessary to reconsider tea glasses and their serving accessories in accordance with sustainable design considerations. The target user group was local users and the environment was households, offices, cafeterias, tea houses and outdoor vendors. The main goal was to develop engaging design solutions incorporating local usage patterns and encouraging sustainable practices. The project duration was eight weeks. The stages of the project included: research; idea generation; factory visit; preparation of design ideas portfolio and mock-ups; preliminary evaluation; and final evaluation. The project had many technical constraints for students to consider. There also were concerns from students on how they would be able to provide variety in designs for a product with many alternatives in the market, and that is very small in size, leaving limited room for design interventions. This paper focuses on the methods offered by the course instructors for idea generation and variety; and design strategies followed by students for the diversification of their design ideas from those of their studio peers and from products available in the market. The 54 preliminary design ideas and 27 final design ideas are investigated as to their themes and project objectives. The design strategies that students have used in developing design ideas for sustainability in tea glasses are identified. It is expected that the design strategies will contribute to those interested in the design and development of glass products.

Keywords: *Turkish tea glass; tea set design; industrial design; idea generation; sustainability; design strategies; design education*

Session	Product Design
Date	NOVEMBER 21, 2019, THURSDAY
Time	12:30 – 12:50
Hall	SAMATYA
Chair	CEMİL TOKEL

HANDMADE GLASS CRAFTSMANSHIP TRADITION AND ITS IMPORTANCE IN TERMS OF SUSTAINABILITY

Solmaz Karabaşa
Ministry of Culture and Tourism, Turkey

The aim of this study is to reveal the importance of handmade glass craftsmanship tradition with regards to the sustainability of glass art and life. Handmade glass tradition has two dimensions: one is the artistic side thanks to the uniqueness of the product, and the other is a craft side because it is produced in order to meet the needs In both cases the tradition of craftsmanship and mastery are of equal fundamental importance. Any craftsmanship is based on the production of tools and equipment that people need. This is how culture is born. Culture is vital for the survival of humanbeings. Based on intangible cultural heritage inventory studies conducted in Turkey, handmade glass tradition has been identified as an element to be safeguarded. Since safeguarding of intangible cultural heritage element ensures the viability of that element, the issue of “transference” of tradition becomes important . Like in many parts of the world, handmade glass tradition in Turkey too, has maintained its viability by way of master-apprenticeship. Unfortunately, nowadays handmade glass tradition in Turkey is under the threat of extinction as the traditional method of transfering skill based on master-apprentice relationship could not be maintained as before. The tradition of craftsmanship or mastery are not limited to sustaining the tradition of handmade glass solely as an object of cultural heritage; instead, they are also aimed at protecting the nature, as they represent a form of production on a human scale from an ecologist point of view, reducing the pressure on natural resources through the use of recyclable materials. In this study, based on the data obtained from face-to-face interviews with handmade glass masters between 2018 and 2019, the sustainability of craftsmanship tradition and mastery will be discussed within the framework of ecologist ideology principles.

Keywords: *handmade glass tradition, mastery, sustainability, cultural heritage*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

MATERIALS MODELING AND DISCOVERY, PROCESS SIMULATION

ŞİŞECAM

www.glassconference-sisecam.com

Session	Materials Modeling and Discovery, Process Simulation
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:20 – 11:50
Hall	EMİRGAN
Chair	ALTUĞ MELİK BAŞOL

MULTISCALE MODELING OF SPUTTER DEPOSITION ONTO 3D SUBSTRATES

Andreas Pflug (Invited Speaker)
Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany

The strive towards increased throughput, reliability and functional integration of coated products calls for improved deposition processes in terms of substrate size, precision, reproducibility and intrinsic performance of the coating materials. In parallel, economic and environmental targets ask for energy and resource efficiency of process, process chain and life cycle perspective.
On the one hand, the application of detailed, model-driven simulation codes yields the required fundamental insights of the deposition process and thin film growth on an atomistic level. On the other hand, many industrial applications such as model-based in-situ process control or iterative optimization procedures require simulation codes, which are real-time capable. Such codes use simplified, data-driven models, calibrated to specific materials and process conditions. The internal model data either originate from experimental data logging or can be derived from more time-consuming model-driven simulation codes.
The multi-scale simulation approach is demonstrated for a dual cylindrical magnetron sputtering process with rotating turntable. The task is to deposit an optical filter onto the convex side of a lens. The deposition setup includes specialized substrate holders and uniformity masks. A coupled simulation scheme yields the design of the optimized uniformity mask geometry: 3D Particle-in-Cell Monte Carlo (PIC-MC) simulations result in the relative erosion profile on the cylindrical sputter targets. Subsequently, the transport of sputtered material through the coater geometry is modelled via the Direct Simulation Monte Carlo (DSMC) method. Finally, a fast algorithm projects the deposition flux onto the moving and rotating substrate for arbitrary angles of the turntable rotation.
The numerically optimized mask design enables the deposition of a band pass filter on a spherical lens including a tailored film thickness gradient for optical compensation at the non-centered positions. Further application of the coupled simulation framework for different coater and 3D substrate geometries is envisaged in the future.

Coauthors
Stefan Bruns, Tobias Zickenrott, Chris Britze, Michael Vergöhl, Christoph Herrmann

Keywords: *multi-scale simulation, plasma simulation, Monte Carlo simulation, magnetron sputtering, optical filters, 3D substrates, digital twin*

Session	Materials Modeling and Discovery, Process Simulation
Date	NOVEMBER 22, 2019, FRIDAY
Time	11:50 – 12:10
Hall	EMIRGAN
Chair	ALTUĞ MELİK BAŞOL

IMPROVING FURNACE PERFORMANCE BY DESIGN AND OPERATION

Burçin Gül
Şişecam Group, Turkey

One of the efforts to strengthen the competitive power in challenging glass market conditions is to cut the cost of production by efficient use of energy. Since the melting process consumes substantial amounts of energy, specific fuel consumption reduction through improving furnace design is high priority need. Proper furnace design with fine operational tuning can reduce energy consumption in a cost-effective way while maintaining quality performance. All of this will create a positive impact on competitiveness performance in rapidly changing environment.
This study investigated role of each design parameters in combustion space on energy consumption and better management of the temperature profile in glass container furnaces. In order to have a better understanding on the combustion behavior and hence furnace performance, effect of crown height, port design, burner type and gas velocity, distance between burner and glass surface on flame form, temperature and velocity distributions was first evaluated individually for a container furnace. Interaction of the design parameter with others was examined by applying stepwise approach. After conducting extensive computations by Şişecam Furnace Model and obtaining feedback from operational sites, it was well understood that what role design parameter plays in in flame formation and the amount and distribution of energy transferred to the glass. More importantly, these parameters need to be optimized specifically for different furnace sizes, specific melting rates and for different production types. In recently commissioned Şişecam container furnaces, an additional %7 of energy reduction has been realized, %4 resulting from combustion space design improvements. This paper won the Michael Garvey Award 2019 for the best paper at the Furnace Solutions (FS-14) conference hosted by the Society of Glass Technology (SGT) in Stoke on Trent (UK).

Keywords: *container, furnace, design, operation, energy, modelling*

Session	Materials Modeling and Discovery, Process Simulation
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:10 – 12:30
Hall	EMIRGAN
Chair	ALTUĞ MELIK BAŞOL

IMPROVING THE QUALITY OF BASIC CHROMIUM SULPHATE BY LEAN SIX SIGMA- DMAIC APPROACH

Nadiye Gür Hız, Mehmet Bahadır Acar, Dilay Kızışar
Şişecam Group, Turkey

Basic chromium sulphate (Chromium hydroxy sulphate, "$Cr_x(OH)_y(SO4)_z(H2O)_t$ + nNa_2SO_4", BCS) is an important chemical product used in the chrome tanning process of skins/ hides. Leather tanned with BCS is resistant to attacks of bacteria and stable even at temperatures greater than 100 °C. Commercially BCS is produced by reducing sodium dichromate by organic chemicals like sugar/glucose or inorganic chemicals like sulphur dioxide (SO_2). BCS products with different basicities (Cr/OH ratio) are available. BCS solution can directly be used in the leather tanning process or can be used as a powder after drying. BCS powder has cheaper transportation cost and it is dissolved easily in water. In some cases, like storing BCS powder under warm or hot conditions may cause difficulty in dissolving; but quality of the BCS is controlled closely and standard product is provided to customers. In the current study, quality of the inorganically reduced BCS produced in Soda Sanayii A.Ş. Kromsan plant has been improved by using Lean Six Sigma- DMAIC Approach. Lean Six Sigma is a methodology that is implemented by many companies in order to reduce the defects of production and business processes, increase the productivity, profitability, and customer satisfaction continuously. Studies included these steps: 1. Define: In the first step, project was defined and targets were quantified. 2. Measure: Data of SO_2 absorption/ sodium dichromate reduction and spray drying processes were collected by utilizing distributed control system (DCS) and laboratory analyses. 3. Analyze: In the third step, data of 87 process parameters were analyzed. Parameters affecting solubility of BCS under hot storage conditions were found as a result of regression analyses. 4. Improve: Results of the analyses were implemented to the plant. 5. Control: Standardization, documentation and monitoring plan were prepared for sustainability of the improvement.

Keywords: *six sigma, basic chromium sulphate*

Notes: *Project Leader: Dr. Nadiye Gür Hız Project Champion: Fatih Aksu Sponsors: F. Tamer Akköseoğlu, Mehmet Güler Lean Six Sigma Advisor: Sümmani Karalar- Master Black Belt (APEC Danışmanlık) Project Members: Dr. M. Bahadır Acar, Dilay Kızışar, Nadire Soran, Ali Tanrıverdi, Ahmet Can Şeker, Altuğ Bayram, Fatih Aksu, Cem Batmaz, Yunus Karaat, Cansu Dinçbudak, Özgür Ergin, Bülent Bağırkan, Süleyman Kurultay, Seden Koç*

Session	Materials Modeling and Discovery, Process Simulation
Date	NOVEMBER 22, 2019, FRIDAY
Time	12:30 – 12:50
Hall	EMIRGAN
Chair	ALTUĞ MELIK BAŞOL

INCREASING THE CONVERSION EFFICIENCY OF CHROMITE TO SODIUM MONOCHROMATE

Seda Yilmaz, Nadiye Gür Hız, Oğuz Ay, Göktuğ Özdemİr
Şişecam Group, Turkey

Kromsan Chromium Compounds Factory in Mersin, which is active in the chromium sector, is producing the world's most preferred basic chromium sulphate. In addition, it is the world leader in sodium bichromate and chromic acid products. It also offers alternative chemicals with chromium derivatives. The main raw material of all these chromium products is sodium monochromate. Sodium monochromate is formed by the reaction of chromite, soda and oxygen under suitable conditions. In order to increase the conversion efficiency of chromite to sodium monochromate, which is 'yield', a lean six sigma project was set up. In this project, which involved 14 people, it was first decided which parameters to be followed. Samples were taken for approximately six months after the preparation of data plan. In this process, the production unit was followed, and the data were collected without interfering with the production process. Some of the parameters followed are as follows; content and grain size of feedstock, feed rate, solid inlet and outlet temperature of the kiln, inlet flow rate of air, natural gas and oxygen, rotational speed of the kiln, yield of the main reaction. After collection of data, regression analysis was performed on Minitab and formulated an equation. According to this equation, the parameters that have the greatest effect on yield and the required values of these parameters were determined. In order to see the effect of these parameters in the real production process, a trial plan was prepared, and then it was tested in the process. It was observed that the yield increased according to the test results. The increase in yield has a significant positive effect on sodium bichromate production. In this project, which is deal with within the scope of lean six sigma, upon the positive results, critical parameters and yield are kept a record on a daily basis to ensure the continuity of productivity increase.

Keywords: *chromite, sodium monochromite, lean six sigma*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

POSTER PRESENTATIONS

ŞİŞECAM

www.glassconference-sisecam.com

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

INVESTIGATION OF SURFACE ROUGHNESS AND PLASMA TREATMENT AFFECTS ON DURABILITY OF SUPERHYDROPHOBIC COATINGS

Eylül Demir [1], Fatih Büyükserin[2]
[1]Aselsan, Turkey
[2]TOBB ETU, Turkey

Inspired by lotus leaves and gecko feet, superhydrophobic surfaces have received great interest in academic and industrial areas due to their self-cleaning and water-repellent properties wherein the water contact angle (CA) is greater than 150° and sliding angle (SA) is lower than 10° [1]. It is well known that maximum accomplishable CA with a water droplet on a flat surface is around 120° [2]. On the other hand, the combination of suitable surface roughness and low surface energy materials is a successful way to prepare superhydrophobic surfaces [3]. Although thermal stability of the coatings modified with different silane groups are studied, resistance to tape test is not investigated which is needed to apply to use superhydrophobic surfaces in daily life [4]. In this study, thermally stable, highly transparent and permanent against the tape test superhydrophobic coatings with 170° CA and 10° SA were obtained. Atomic force microscopy (AFM) was used to measure the surface roughness which is optimized by chemical etching with acidic solutions at various times. In addition, MTMS-TEOS mixture was spin coated to lower the surface energy. The best samples were exposed to oxygen plasma to enhance the resistance to the tape test. After tape test, 5° angle loss was observed on plasma treated samples while non-treated ones have around 50°.

Keywords: *superhydophobic, thermally stable, transparent, glass coating*

Notes: References [1] Ma, M., & Hill, R. M. (2006). Superhydrophobic surfaces. Current opinion in colloid & interface science, 11(4), 193-202. [2] T. Nishino, M. Meguro, K. Nakamae, M. Matsushita, Y. Ueda, The lowest surface free energy based on-CF3 alignment, Langmuir 15 (1999) 4321–4323. [3] Bhushan, B., & Jung, Y. C. (2011). Natural and biomimetic artificial surfaces for superhydrophobicity, self-cleaning, low adhesion, and drag reduction. Progress in Materials Science, 56(1), 1-108. [4] Budunoglu, H., Yildirim, A., Guler, M. O., & Bayindir, M. (2011). Highly transparent, flexible, and thermally stable superhydrophobic ORMOSIL aerogel thin films. ACS applied materials & interfaces, 3(2), 539-545

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

INVESTIGATIONS ON THE MICROSTRUCTURE PROPERTIES OF INCONEL 625 AND AISI 316L DISSIMILAR WELDED JOINTS

Fatih Dökme
Şişecam Group, Turkey

This study foucesd on the microstructure of the dissimilar metal welding of Inconel 625 and AISI 316L using Continuous Current Gas Tungsten Arc Welding (CCGTAW) and Pulsed Current Gas Tungsten ArcWelding (PCGTAW) processes with ERNiCr-3, TIG 316L and twisted (ERNiCr-3 and TIG 316L) fillers. Microstructure studies were carried out using an optical microscope and Scanning Electron Microscopy (SEM)/Energy Dispersive X-Ray (EDAX). The results of the study showed the existence of a partially melted zone (PMZ) on the AISI 316L side. Weld zone (WZ) analysis showed the existence of a multi-directional grain growth on the 316L side in all specimens, although less growth was found on the Inconel 625 side. Grain growth almost disappeared using PCGTAW with twisted fillers. SEM/EDAX investigations indicated that secondary deleterious secondary phases were tiny and white in five experiments. However, a meager amount of precipitates occurred in PCGTA welding with twisted fillers. Moreover, these were particularly innocent precipitates, represented by black dots in images, whereas other tiny white secondary phases are known to be brittle. As a result, PCGTA welding with twisted fillers exhibited the best metallurgical properties.

Keywords: *dissimilar welding, super alloy, inconel 625, aisi 316l, microstructure*

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

THE USAGE OF COLOR GLASSES IN GLASS MOLD FORMING TECHNIQUE

Göktuğ Günkaya, Ayşenur Sarı
Anadolu University, Turkey

Glass mold forming technique has been one of the most preferred application technique in glass art history since ancient times. Throughout history, this technique have been developed and changed by thriving glass production processes either for artistic or industrial applications. Almost the same techniques are used in the glass production today but faster, more professional and with larger quantities. In addition to these, application environments, raw materials, materials and scientific accumulation have been developed. One of the most important parameters in determining the effect of these techniques is the color of the glasses used in that technique. In this way, the psychological effects of colors such as joy, sadness and happiness have become an important factor in the choice of colors for some glass artists to for the desired impression. With this motivation, the colors used in the mold forming techniques were investigated and the discoloring / non-discoloring glasses by the heat treatment in the furnace were determined. It has been shown that different effects can be achieved in a controlled manner as a result of heat treatment for glass depending on temperature and time. The work is a helpful source for achieving the desired color in mold forming technique for glass artists and people who uses glass as an artistic or industrial material.

Keywords: *glass, color glass, glass mold forming technique, glass casting technique, psychological effect of glass colors, glass art*

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

GLASS-CERAMIC MATERIALS FOR OBTAINING PROPPING AGENT

Pavel Laryionau, Yury Pauliukevich, Ekaterina Trusova
Belarusian State Technological University, Belarus

Synthetic propping agents are produced by ceramic technology. In our study, we are demonstrating the possibility of obtaining propping agent in the glass-ceramic form. The glass-ceramic materials were obtained in two steps. On the first step, the glasses with composition R2O – MgO – CaO – Al2O3 – SiO2 (R2O – Na2O, K2O) were obtained with classic melt-quenching technique. Granite siftings with chemical composition, wt. %: SiO2 63.3; Al2O3 14.2; CaO 4.2; MgO 1.6; R2O 6.3; (Fe2O3+FeO) 5.4; TiO2 0.5; other 4.0 were used as an initial reactant. In addition, soda ash, chalk, and boric acid were added to the raw materials. Chromium oxide is used as the initiator of crystallization. The synthesis was performed at a maximum temperature of 1450 °Cin the gas furnace for 2 h and the samples were annealed at 600 °C for 4 h in a muffle furnace. Glasses crystallizability has been evaluated by means of a complex method based on the results of gradient crystallization and differential scanning calorimetry data. The crystallization process is the most active in the temperature range of 800 –1000°C. The phase composition of the bulk crystallization products is represented by pyruxene solid solution of augite type (Ca, Mg, Fe2+) (Mg, Fe2+, Al, Fe3+) [(Si, Al)2O6] and nepheline Na[AlSiO4]. On the next step, glass microspheres were obtained using the method of melt dispersion and were heat-treated at 830–860°C for 10–30 minutes for crystallization. Obtained glass-ceramic granules have high sphericity and roundness with dense structure and are characterized by the absence of pores, reducing its operational characteristics. The bulk density of proppants was 1680 kg/m3, solubility in 15% hydrochloric acid is 0.7%, in a mixture of hydrofluoric and hydrochloric acids is 2.0%.

Keywords: *glass, glass ceramics, propping agent*

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

GARNET BASED GLASS CERAMICS FOR HIGH POWER SOLID STATE LIGHTING

Yauhen Tratsiak
Belarusian State University, Belarus

The light conversion by phosphors is the dominating approach in the fabrication of white light-emitting diodes (LEDs) based on high-brightness InGaN-based blue LEDs. Ce-doped yttrium aluminum garnet Y3Al5O12 (YAG:Ce) is the most common phosphor for white LEDs. The phosphor is usually dispersed in a transparent encapsulation (usually made of polymeric epoxides) covering an InGaN chip. In modern mass-produced white LEDs, the system serves without significant aging throughout the entire chip lifetime of up to 100 000 hours. However, certain applications require white light sources of considerably higher brightness. The increase in brightness is accompanied by heating of the LED to the temperatures that deteriorate the conventional encapsulation materials. This problem is of especial importance for the white light sources based on blue laser diodes. Exploitation of single crystals, ceramics or glass-ceramics as light converting media is a prospective approach to solving this problem. Most of compounds with garnet structure may be obtained in three forms: powder, ceramic and single crystal. Moreover, garnets may be obtained in a glass ceramic form also. Glass ceramics are interesting optical materials that may join both, glasses transparency and luminescent efficiency of the crystalline phase. Furthermore, the crystallites composition and size may be controlled through the glasses composition and synthesis conditions, respectively, that makes possible to impact on the sample's transparency and luminescent efficiency. The current work is focused on the development of garnet based glass-ceramics (YAG:Ce, GGAG:Ce), investigation their structural, photo and radioluminescence properties for use in combination with blue LED lasers.

Keywords: *glass-ceramic, garnet, luminescence*

Session	Poster Session
Date	NOVEMBER 21, 2019, THURSDAY
Time	15:00 – 16:00
Hall	TOPKAPI FOYER

NEW GLASS CERAMIC LUMINESCENT MATERIALS FOR A WIDE APPLICATION

Tatsiana Salamakha, Yauhen Tratsiak, Ekaterina Trusova
Belarusian State Technological University, Belarus

Development of new cheap and effective luminescent materials is one of the vital tasks in materials science. It is related its tremendous applications in different fields including high energy physics, photonics, medicine, lighting, agriculture and others. Among them iodides of alkaline earth elements doped with Eu2+ are attractive due to relatively low cost and good optical properties. Main problems restraining their wide application are hygroscopicity and structural anisotropy. The first one needs encapsulation of phosphor in hermetic transparent container for its protection from moisture, while the second makes difficult synthesizing crystals of high volume. Both problems may be solved by obtaining phosphors in glass ceramic form. All approaches for glass ceramics synthesis may be divided in 2 groups: (i) mixing powders of initial phosphors and glasses with subsequent heat treatment; (ii) growth of phosphor directly in glass during crystallization. Due to hygroscopicity and low thermal stability of alkaline earth elements iodides first approach is more suitable for its synthesis. Thus, the aim of this work is development of the method of glass ceramics based on iodides of alkaline earth elements doped with Eu2+ synthesis, study its structural, morphological and luminescent properties. The glass ceramic samples were prepared by immerging MI2:Eu (M = Mg, Ca, Sr, Ba) powders into glass matrix under heat treatment. MI2:Eu powders were obtained using 2 stages approach: the first stage involved synthesis by a reverse precipitation of MCO3:Eu that were converted into MI2:Eu in the second stage. The XRD data confirm the used synthesis approach being universal for obtaining MI2:Eu samples in powders and glass ceramic forms. The PL bands for these samples correspond to the luminescence of Eu2+ and Eu3+ in MI2, allowing to obtain final glass ceramics with emission color varying from blue to red depending on the composition.

Keywords: *luminescence, eu2+, glass ceramic, iodides*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

THE TRANSFORMATION OF POWER GENERATION FROM GEAR SYSTEM TO THE HYDRAULIC SYSTEM AT ROTARY KILN

Sadık Ünal
Şişecam Group, Turkey

The aim of this thesis is to transform the reducer system of rotary kiln to the hydraulic system. In this way, load strength is increased and consequently equipment failure is reduced, material expenses are decreased, loss of manpower in maintenance is reduced and the continuity of production is ensured. At the rotary kiln, the loads which affect to the gear system is very irregular and mixed. So, these loads cause unstable deformation and stress. For this reason, gears and pinions can wear in a short time however very kindly different materials are chosen. However, the hydraulic system brings us strength to the irregular load effects. For this reason, power generation of gear system rotary kiln is transformed to hydraulic system for obtaining high strength. In this thesis, the comparison between the reductor systems and the hydraulic systems are analysed. The advantages and disadvantages are explained. The function and working principle of rotary kiln is explained. The loads acting on the geared system of rotary kiln is analysed. Deformation and stress analysis are carried out according to incoming loads. In line with the load analysis, the necessary calculations are made for the design of the hydraulic system. Based on the calculations, hydraulic elements are selected and hydraulic system is modelled.

Keywords: *power generation system, hydraulic system, rotary kiln, load*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

ULTRAFAST LASER INSCRIPTION OF NANOGRATINGS IN MULTICOMPONENT GLASSES

Sergey Lotarev, Sergey Fedotov, Alexey Lipatiev, Alyona Pomigueva, Vladimir Sigaev
Mendeleev University of Chemical Technology of Russia, Russia

Birefringent nanoperiodical structures also known as nanogratings which can be inscribed in the bulk of a number glasses and some other oxide dielectric materials by the femtosecond laser pulses were the first example of a principally subwavelength regular structure formed by the light in the inside of materials. They were first demonstrated and described in fused silica in 2003 and since then were extensively investigated and drew much attention due to their controllable birefringence and ability for chemical etching which provided applications in optical data storage, polarization converters and microfluidics. Recently, formation of nanogratings was demonstrated in a set of multicomponent glasses. Here. the inscription of nanogratings in a set of R2O-SiO2 (R=Li, Na, K), Na2O-GeO2 and Na2O-B2O3-SiO2 glasses containing up to 25 mol.% of alkaline oxide is described. We discuss specifics of their formation and corresponding effects which make them substantially different from the well-studied nanograting inscription in fused silica. In particular, we showed a presence of a laser pulse duration threshold below which nanogratings cannot be inscribed in the studied glasses, and accompanying effects of nanocrystallization and nanoperiodical redistribution of sodium cations. Possible ways to practical applications of nanogratings in multicomponent glasses are suggested. This work was financially supported by Mendeleev University of Chemical Technology of Russia (project 034-2018).

Keywords: *alkali silicate glasses, sodium borosilicate glasses, sodium germanate glasses, nanograting, birefringence, femtosecond laser nanostructuring*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

METALLIC GLAZES FOR PORCELAIN FLOOR TILES

Hanna Shymanskaya, Maryna Sakalowskya
Belarusian State Technological University, Belarus

Recently, porcelain tiles decorated with metallized coatings have proved extremely popular. In the Republic of Belarus, imported metallic glazes are used in the production of ceramic granite tiles. Dependent of producers on imports puts a premium on the developing of glaze compositions using existing local raw materials. This will ensure import substitution and reduction in the cost of production. In this study, a glaze system consisting of CuO, dolomite, fusible clay, quartz sand and kaolin is systematically developed to produce raw metallic glazes for stoneware bodies. The study of physical-chemical properties founded that, synthesized glaze coatings conformed to requirements of technical standards documents, as well as had high decorative effect: color – dark gray, metallic effect; surface texture – glossy, semi-matte; luster – 40–100 %; microhardness – 5100–7500 MPa; the linear thermal expansion coefficient – (65.9–73.4)·10–7 K–1; heat resistance – 150–200 ºC; class of surface abrasion resistance – 2. In addition, all glaze coatings were chemically stable. The following crystalline phases were identified in the glazes anortite (CaO · Al2O3 · 2SiO2) and tenorite (CuO). The tests performed under production plant conditions at Keramin JSC (Minsk, Republic of Belarus) showed that the newly developed coatings can be used in industrial manufacturing.

Keywords: *metallic glaze, porcelain floor tile, crystalline phases, structure, abrasion resistance*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

FEATURES OF THE FORMATION OF LOW-MELTING NON-TRANSPARENT GLASSY COATINGS

Ivan Levitskii
Belarusian State Technological University, Belarus

Glaze coatings are synthesized in the Na2O–K2O–CaO–ZnO–Al2O3–B2O3–ZrO2–SiO2 system with the content of components, wt. %: SiO2 55.0–59.0; B2O3 12.0–16.0; ZnO 4.0–8.0. The remaining oxides were introduced in amount, wt.%: R2O (Na2O + K2O) 8.0; CaO 5.0; Al2O3 6.0; ZrO2 6.0. The variation step was 1.0%. The frits were synthesized in a gas furnace at 1420–1450 ° C for 6 h. Transparent homogeneous frits were formed in the studied system, the crystallization of which established the formation of a crystallization film in the temperature range 610–670 ° C. The melting temperature of granules is 900–950 ° C. Using differential thermal analysis, the presence of an endo-effect at 610–690 ° C, associated with the point of softening of glasses, was established. At 950–995 ° C, an exo-effect due to crystallization processes is observed. The glaze slurry was prepared by grinding the frits to a residue on a № 0056 sieve (10858 holes / cm2) with the addition of 10 wt.% refractory clay. Glaze suspension was sprayed on the surface of ceramics. The coatings were fired in the temperature range 950–1100 ° C in an electric chamber furnace. Coatings are non-transparent and characterized by high levels of whiteness. The main crystalline phase in the coatings is zircon (ZrSiO4). The shine of the coating was 55–80%, whiteness 60–85%. The temperature coefficient of linear expansion of the coating was (50.3–53.2) 10–7 K – 1. The thermal stability of the glaze compositions was in the range of 200–250 ° C. The microhardness of the coatings was 6830–8120 MPa. It was established that high-quality coatings are formed when the content of oxides like ZnO and ZrO2 is in the amount of 10–14 wt.% with the ratio of glass-forming oxides (SiO2 + Al2O3) / (Na2O + K2O) of 6.0–6.4. Studies have established the absence of migration of boron and aluminum ions into model media simulating food liquids.

Keywords: *glaze coatings, crystalline phase, whiteness*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

TECHNOLOGICAL AND PHYSICAL-CHEMICAL PROPERTIES OF BASALT FIBERS

Yury Pauliukevich[1], Ludmila Papko[1], Ekaterina Trusova[1], Orhan Kendir[2], Sergey Khlystov[2], Elena Soldzhuner[2]
[1]Belarusian State Technological University, Belarus
[2]ETIMADEN-Etiproducts Ltd., Russia

High mechanical strength, resistance to corrosion effect of aggressive media, good thermal resistance and relatively low cost of continuous basalt fibers predetermine wide scope of their application – primarily as a reinforcement material for various composites and also as the thermal insulation materials of the broadest designation. At the same time, instability of chemical composition of the basalts, presence of high-melting point crystalline phases like plagioclases with prevalence of the anorthite component, olivine and quartz cause chemical inhomogeneity of the melts. It has resulted in high melting temperatures of the rocks and high temperatures of fiber formation, and breakage of the fiber in zone of its formation. Modification of the composition of the continuous basalt fibers was performed in order to control their technological properties, at that, the basalt-chalk, basalt-dolomite and basalt-colemanite compositions were applied as raw materials. The compositions comprised fine crushed trap rock and 5–20 mass fractions of the modifying component. Use of the colemanite of ETIMADEN-Etiproducts Ltd in the compositions of raw materials seems optimal in terms of the effect exerted on the technological properties. Joint insertion of CaO and B2O3 into the composition of the basalt glasses leads to significant decreasing of the viscosity and upper temperature of crystallization, and consequently – for decreasing of the fiber formation temperature by 50...80 oC. Reduction of viscosity and surface tension of the boron-containing basalt melt provides for chemical and structural homogeneity of basalt fibers. Influence of the aforementioned factors results in increasing of the mechanical strength of the modified basalt fibers obtained using the laboratory stand. In addition, the modified basalt fibers are characterized by high parameters of water and alkali resistance.

Keywords: *basalt, colemanite, continuous basalt glass fiber*

Session	Poster Session
Date	NOVEMBER 22, 2019, FRIDAY
Time	10:00 – 11:00
Hall	TOPKAPI FOYER

INFLUENCE OF SILICON-ORGANIC COMPOUNDS ON THE CRYSTALLIZATION ABILITY OF FUSED SILICA GLASSES OBTAINED BY A GAS-FLAME METHOD FOR USE IN THE PRODUCTION OF REFRACTORIES

Yury Pauliukevich, Mikalai Hundzilovich
Elarusian State Technological University, Belarus

Fused silica ceramics is a special group among the materials used to obtain refractory products. The characteristics of fused silica ceramics are isotropic and are determined by the main raw material component - fused silica glass, due to it has high chemical resistance, fire resistance, radiation resistance, electrical insulation properties, significant heat resistance and high operating temperatures. The use of fused silica ceramics is limited due to difficulties associated with undesirable crystallization processes during sintering, which occur at temperatures above 1100 °C. Crystallization processes intensity increases with increasing temperature, which necessitates the search for ways to reduce the sintering temperature of fused silica ceramics. Fused silica glass is thermodynamically unstable, since its free energy is greater than the free energy of any crystalline form of silica. To reduce the firing temperature in the preparation of fused silica ceramic materials, it is proposed to use organosilicon compounds, the pyrolysis of which leads to the formation of SiO2, CO2, and H2O. Currently, the influence of nature and the amount of organosilicon compounds on the physicochemical properties, structure and phase composition of fused silica ceramic materials has not been studied enough and needs to be clarified. It was found that the addition of polyphenylsiloxane to the composition for the production of fused silica ceramics provides an increase of crystallization resistance up to 1300 °C due to the formation of a layer of amorphous silicon oxide on the fused silica glass particles surface which leads to decrease diffusion processes in structure of the material and increases the content of hydroxyl groups in the glass. This phenomenon leads to prevent the formation of cristobalite. Binder properties of polyphenylsiloxane were experimentally confirmed due to high plasticizing properties, which provide strong bonding of particles in the structure of the material.

Keywords: *fused silica ceramics, glass, refractories, polyphenylsiloxane, binder, heat resistance, crystallization*

ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

combined with

34th Şişecam Glass Symposium

Glass in the Sustainable Future:
ACHIEVING WHAT IS POSSIBLE...

November 21-22, 2019

TOURIST INFORMATION

ŞİŞECAM

www.glassconference-sisecam.com

Time
Turkey is 3 hours ahead of the Greenwich Mean Time (GMT + 3)

Health & Safety
Emergency telephone numbers; Police 155, Medical 112, Fire 110

Climate and Clothing
In late November, the weather in Istanbul is generally cool and slightly overcast. Daily temperatures average at 18 °C (64 °F). Please note that temperatures might noticeably drop during night time, so bringing a suitable outerwear is recommended.

Cuisine and Restaurants
Istanbul's culinary landscape is among the most varied and extensive in the world, and there are many restaurant alternatives offering the classics of Turkish cuisine as well as several exemplary interpretations of international cuisine. In every part of the city there are small cafés, restaurants and kiosks serving excellent food in the lower price category. The attendees, regardless of their gustatory aim will not lose too much time before discovering a satisfying option.

Please note that the adjacent shopping mall houses a big food court, individual restaurants and several cafes, and the working hours (10:00 AM to 22:00 PM) suitably cover and extend beyond the conference schedule except for the breakfast.

Medical Services
Having travel insurance is highly recommended. For minor problems, it's customary to ask at a chemist/pharmacy (Eczane) for advice. Make sure you know the generic name of your medicine; the commercial name may not be the same in Turkey. The word for hospital is 'Hastane'. Most doctors in Turkey can communicate in English.

Money and Currency Exchange
The unit of currency is the Türk Lirası (Turkish Lira; TL). TL is fully convertible to other currencies and there is no black market. There are many currency exchange offices scattered throughout the city, as well as the ones at each city airport. The ones at the airports operate 24/7 whereas the others typically operate between 9:00 AM and 7:00 PM. Finally, there is one exchange office inside the adjacent shopping mall. At each location, the instantaneous buying and selling prices will be listed on electronic boards. Indicative exchange rates between TL and other national currencies can be accessed from several online platforms. One reliable link is https://www.isbank.com.tr/EN/prices-and-rates/foreign-exchange-rates/Pages/foreign-exchange-rates.aspx

ATMs
Automated teller machines (ATMs, cashpoints) are common in Istanbul. All of the banks and some smaller banks have ATMs. Virtually all of them offer instructions in English, French and German and will pay out Turkish liras when you insert your bank debit (cash) card. ATMs will also pay cash advances on Visa and Mastercard. The limit on cash withdrawals generally vary from TL 1000 to TL 2000 per day, though the exact number varies from bank to bank.

Credit cards
Most hotels, car-rental agencies, shops, pharmacies, entertainment venues and restaurants will accept Visa and Mastercard; Amex isn't as widely accepted as the others and Diner's is perhaps the least accepted card system. Budget hostels and hotels, and basic eateries usually accept cash only.

Traveller's cheques
If you have traveller's cheques, you will have to change them at a bank or post office. Exchange bureaux do not typically cash them. You will need to show your passport.

Taxes & Refunds
Turkey has a value-added tax (VAT) known as the katma değer vergisi (KDV). Don't forget to ask the shopkeeper for the Global Refund Check for your purchase over 100 TL + VAT in one store. Some shops display a blue, grey and white 'Tax Free Shopping' sign in their window, conveniently signalling that they participate in the refund scheme. When you are leaving Turkey, simply present your 'tax free' invoices and passports to the customs officials. The staff in charge will stamp the receipts and your Global Refund invoice/check. They will process the refunds for purchases that have been made up to 3 months prior. You have several choices to collect your refund. You can have immediate cash at your nearby Cash Refund Office, or mail your customs validated check to Global Refund-Turkey within 90 days for direct crediting of a chosen credit card or a bank cheque to be sent to your address. İstanbul Airport Cash Refund Office or Isbank is open 24/7. Sabiha Gökçen Airport Isbank branch is open 24/7. Karaköy Harbor Isbank branch is also open 24/7.

AUTHOR INDEX

Notes

Notes

Notes

Notes

Notes

Notes

Notes

CONTRIBUTORS

RHI MAGNESITA

LAND AMETEK

CelSian Glass & Solar

GS GLASS SERVICE

SEFPRO it's a matter of trust.

Life Is On | Eurotherm by Schneider Electric


ŞİŞECAM