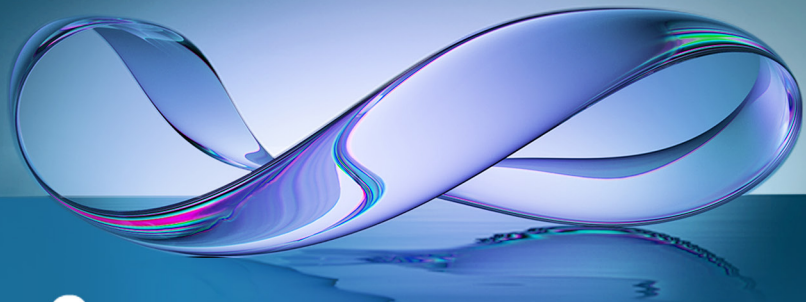
ŞİŞECAM

LET'S MEET AT

38th INTERNATIONAL GLASS CONFERENCE



COLLABORATE 2 INNOVATE

FOR A SUSTAINABLE FUTURE

2-3 NOV 2023

SHERATON GRAND
ISTANBUL ATASEHIR

PUBLISHED BY

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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.

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WELCOME MESSAGES

Dear Colleagues and Guests,

Şişecam has been growing with the light of science and technology since the day it was founded.

Şişecam initiated the first Şişecam Glass Conference in 1985 to foster innovation in its ecosystem. For the past years this conference has evolved into a prominent scientific platform for the global glass industry.

Bringing together glass manufacturers, scientists, technologists, and leaders, the Conference has a significant role for the industry.

Glass, one of the most strategic materials of nature, undergoes extraordinary transformation when combined with intelligence and creativity.

As a major global player in the glass and chemicals industries, Şişecam continues to innovate and collaborate for a sustainable future and takes responsibility for protecting the planet, empowering society and transforming life.

We are pleased to welcome you at the 38th Şişecam International Glass Conference under the theme of "Collaborate to Innovate: For a Sustainable Future".

We believe that this Conference is an ideal opportunity to reach out to the world's leading scientists and researchers and discuss the constantly expanding usage areas and endless potential of glass.

We look forward to welcoming you.

Görkem Elverici
Conference President
Chief Executive Officer
Şişecam

COMMITTEES

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38th INTERNATIONAL GLASS CONFERENCE

PROGRAM AT A GLANCE

COLLABORATE 2 INNOVATE

FOR A SUSTAINABLE FUTURE

2-3 NOV 2023

SHERATON GRAND
ISTANBUL ATASEHIR

ISTANBUL TIME (CET +02:00)	2 NOVEMBER 2023, THURSDAY
REGISTRATION 08:00 - 09:00	MAIN ENTERANCE
09:00 - 09:30	Great Room A Welcome/Opening Remarks
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10:10 - 10:40	COFFEE BREAK FOYER A
PLENARY SESSION 10:40 - 12:00	COLLABORATE TO INNOVATE: For a Sustainable Future
12:00 - 13:00	LUNCH BREAK THE CITY BRASSERIE
PARALLEL SESSIONS 13:00 - 14:50	GLASS MELTING AND FORMING PROCESSES Great Room A
PARALLEL SESSIONS 13:00 - 14:50	GLASS SURFACES, INTERFACES AND COATINGS (I) Great Room B
14:50 - 15:20	COFFEE BREAK FOYER A&B
PARALLEL SESSIONS 15:20 - 17:10	ENERGY, ENVIRONMENT AND SUSTAINABILITY (I) Great Room A
PARALLEL SESSIONS 15:20 - 17:10	ADVANCED TECHNOLOGY MATERIALS (I) Great Room B
POSTER SESSIONS 17:10 - 18:00	FOYER A

ISTANBUL TIME (CET +02:00)	3 NOVEMBER 2023, FRIDAY
REGISTRATION 08:00 - 09:00	MAIN ENTERANCE
PARALLEL SESSIONS 09:00 - 11:00	DIGITALIZATION Great Room A
PARALLEL SESSIONS 09:00 - 11:00	ADVANCED MATERIALS AND DEVICES (II) Great Room B
11:00 - 11:20	COFFEE BREAK FOYER A&B
PARALLEL SESSIONS 11:20 - 13:00	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II) Great Room A
PARALLEL SESSIONS 11:20 - 13:00	PRODUCT DESIGN (I) Great Room B
13:00 - 14:00	LUNCH BREAK THE CITY BRASSERIE
PARALLEL SESSIONS 14:00 - 16:00	FUNDAMENTALS OF GLASS SCIENCE Great Room A
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ŞİŞECAM

38th INTERNATIONAL GLASS CONFERENCE

SCIENTIFIC PROGRAM

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FOR A SUSTAINABLE FUTURE

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ISTANBUL ATASEHIR

ISTANBUL TIME (CET +02:00)	2 NOVEMBER 2023, THURSDAY
08:00 - 09:00	**REGISTRATION** Main Enterance & Foyer
OPENING	GREAT ROOM A
09:00 - 09:15	**GÖRKEM ELVERİCİ** *Chief Executive Officer, Şişecam, TR*
09:15 - 09:30	**Prof. Dr. AHMET KIRMAN** *Chairman and Executive Member of the Board, Şişecam, TR*
PLENARY SESSION	GREAT ROOM A
CHAIR	**Dr. İLKAY SÖKMEN** *Glass Technologies Director, Şişecam, TR*
09:30 - 10:10	**Truly Transparent Solar for Electricity Generating Façades** **Dr. Miles Barr (KEYNOTE)** *Co-Founder and Chief Technology Officer, Ubiquitous Energy, US*
10:10 - 10:40	**COFFEE BREAK**
10:40 - 11:20	**Decarbonization Pathway of the Glass Industry, Challenges, Opportunities for Different Segments and Possible Solutions Regarding Different Energy Inputs** **Erik Muijsenberg (KEYNOTE)** *Vice President, Glass Service A.S., CZ*
11:20 - 12:00	**LionGlass: A Phosphate-Based Approach to Carbon-Neutral Glass Manufacturing** **Prof. Dr. John C. Mauro (KEYNOTE)** *Department of Materials Science and Engineering, The Pennsylvania State University, US*
12:00 - 13:00	**LUNCH BREAK** THE CITY BRASSERIE

PARALLEL SESSIONS	GREAT ROOM A GLASS MELTING AND FORMING PROCESSES
CHAIR	**TOLGA UYSAL** *Melting Technologies&Engineering Director, Şişecam R&D, TR*
RESP. MEMBER	**ŞİRİN USTABAŞI** *Senior Researcher, Şişecam R&D, TR*
13:00 - 13:30	**Mixing Electrodes (Bubbler & Electorode All in One)** **Dr. Marian Klisch (INVITED)** *Head of R&D, Forglass Sp., PL*
13:30 - 13:50	**Pushing the Limits of Production in Float Furnaces** **Burçin Gül Arslanoğlu** *Exec. Senior Researcher, Modelling, Şişecam R&D Center, TR*
13:50 - 14:10	**Glassdigital - Digitalisation of Glass-Development** **Dr. Martin Kilo** *Senior Scientist, Fraunhofer ISC, DE*
14:10 - 14:30	**Sorg's "CLEAN-Melter": Advanced Technology for a Sustainable Future** **Dirk Schnurpfeil** *Research And Development Manager, Nikolaus Sorg GmbH & Co. KG, DE*
14:30 - 14:50	**Melting Behavior of Natural Inclusions in Raw Materials** **Pelin Akkaya** *Senior Researcher, Microanalysis, Şişecam R&D Center, TR*
14:50 - 15:20	**LUNCH BREAK** THE CITY BRASSERIE

PARALLEL SESSIONS	GREAT ROOM B GLASS SURFACES, INTERFACES AND COATINGS
CHAIR	**OZAN ÖZER** *Coating Technologies Director, Şişecam R&D, TR*
RESP. MEMBER	**ÇAĞRI OCAK** *Senior Researcher, Şişecam R&D, TR*
13:00 - 13:30	**From Lab to Pilot – Opportunities and Challenges of Large-Area Inline Flash Lamp Annealing** **Thomas Preußner (INVITED)** *Deputy Group Leader, S2S Sputtering & PECVD, Fraunhofer FEP, DE*
13:30 - 14:00	**Enhancing Solar Panel Efficiency Through Wide-Angle Anti-Reflection Technologies** **Dr. Calvin Cheng (INVITED)** *Chief Operating Officer and Co-Founder, Edgehog Advanced Technologies Inc., CA*
14:00 - 14:20	**Graphene Oxide Doped Sizing Effect on Glass Fiber Reinforced PA Mechanical Properties** **"Dr. Göksenin Kurt Çömlekçi** *Exec. Sn. Researcher, Atmospheric Coating, Şişecam R&D Center, TR*
14:20 - 14:40	**TiO_2/SiO_2 Aerogel Coating on Glass Provides Anti-Reflection, Water Harvesting, Anti-Bacterial and Self-Cleaning Properties** **Sezen Öykü Kınacı** *Master's Student, Middle East Technical University, TR*
14:40 - 15:00	**Development of Water Based Silver Mirror with Improved Durability** **Zeynep Aydın** *Researcher, Atmospheric Coating, Şişecam R&D Center, TR*
14:50 - 15:20	**COFFEE BREAK** FOYER A & FOYER B

PARALLEL SESSIONS	GREAT ROOM A ADVANCED MATERIALS AND DEVICES (I)
CHAIR	**SERKAN ŞAHİN** *Tech. Monitoring & Impl. Dir.,* *Şişecam Production Tech.,TR*
RESP. MEMBER	**EMRE ÇELİK** *Project Engineer, Şişecam R&D, TR*
15:20 - 15:50	**HY South Marmara Hydrogen Valley Project** **M. Volkan Duman (INVITED)** *Energy Manager, Manufacturing Ind., T.C. South Marmara Development Agency, TR*
15:50 - 16:10	**Hydrogen Combustion Technologies for a Smooth Transition** **Luc Jarry (ONLINE)** *Glass and Metal Senior Market Director, Air Liquide, FR*
16:10 - 16:30	**Regenerator Modeling for Energy Optimization** **Sjoerd Stelwagen** *Senior Project Manager, CelSian Glass & Solar B.V., NL*
16:30 - 16:50	**Contemporary Furnace and Process Design for a Sustainable Glass Production** **Ernesto Cattaneo** *Head of Innovation Projects, Stara Glass, IT*
16:50 - 17:10	**The Electrification of The Glass Industry: Learning from The Past and Present to Drive The Future** **Gary Cafe** *Commercial Lead - Green Glass* *Schneider Electric, NL*
17:10 - 18:00	**POSTER SESSIONS**

PARALLEL SESSIONS	GREAT ROOM B ADVANCED MATERIALS AND DEVICES (I)
CHAIR	**M. ARDIÇ YILMAZ** *Marketing Coordinator, Şişecam, TR*
RESP. MEMBER	**ZEYNEP AYDIN** *Researcher, Şişecam R&D, TR*
15:20 – 15:50	**The Future Of Automotive Glazing** **Ozan Nalcıoğlu (INVITED)** *Vehicle Hardware Modules Engineering Lead, Ford Otosan, TR*
15:50 – 16:20	**Opportunities and Challenges for VIPV** **Dr. Bonna Newman (INVITED)** *Head of Product Solar, Lightyear* *Board Chair, ASOM Alliance for Solar Mobility, NL*
16:20 – 16:40	**Virtualization of Optical Qualification for Windshield Camera Zones** **Stephane Baldo** *CTO, SYNERGX Technologies, CA*
16:40 – 17:00	**Developing of Transparent Radar Absorber Surfaces** **Utku Er** *Exec. Senior Researcher, Vacuum Coating Tech., Şişecam R&D Center, TR*
17:00 – 17:20	**Developing $P_3HT:WO_3$ Hybrid Thin Films for Applications in Solid State Electrochromic Devices** **Fatma Beyza Yedikardeş Er** *Senior Researcher, Surface Technology, Şişecam R&D Center, TR*
17:20 – 18:00	**POSTER SESSIONS**

ISTANBUL TIME (CET +02:00)	3 NOVEMBER 2023, FRIDAY
08:00 - 09:00	Main Enterance & Foyer
PARALLEL SESSIONS	GREAT ROOM A DIGITALIZATION
CHAIR	**ESRA YAZICI TAHTALIOĞLU** *Data & Analytics Director, Şişecam IT, TR*
RESP. MEMBER	**EMRE ÇELİK** *(Project Engineer, Şişecam R&D, TR*
09:00 - 09:30	**Bridging the Generation Gap with Data-Driven Processes** **Dr. Yakup Bayram (INVITED)** *CEO, Co-Founder, PaneraTech, Inc., US*
09:30 - 10:00	**Challenges toward Furnace Digital Twin** **Taiga Seki (INVITED)** *Manager of Innovative Technology Laboratory, AGC Group, JP*
10:00 - 10:20	**Şişecam Digitalization Through the Looking Glass of Big Data and Data Analytics** **İbrahim Şahinoğlu** *Data Architect, Data & Analytics, Şişecam IT, TR*
10:20 - 10:40	**VSight - Remote Collaboration and Knowledge Platform** **Can Danışman** *Business Development Representative, VSight UAB, TR*
10:40 - 11:00	**Machine Learning Based Modeling of an Industrial Thermal Cracking Furnace** **Melike Duvanoğlu** *Master's Student, Koç University, TR*
11:00 - 11:20	**COFFEE BREAK** FOYER A & FOYER B

PARALLEL SESSIONS	GREAT ROOM A ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
CHAIR	**DR. BURCU APAK** *Innovation & Quality Manager, Şişecam R&D, TR*
RESP. MEMBER	**SEÇİL AYDIN** *Researcher, Şişecam R&D, TR*
09:00 - 09:30	**Glass-Ceramics** **Prof. Dr. Edgar Dutra Zanatto (INVITED)** *Materials Science and Engineering, UFSCar, BR*
09:30 - 10:00	**Current Understanding of the Properties and Formation of Glass Fibers** **Prof. Dr. Yuanzheng Yue (INVITED)** *Chemistry and Bioscience Dept., Aalborg University, DK*
10:00 - 10:20	**Composition Optimization for Improved Chemical Durability on Crystalline Glassware Products** **Yekta Ateş Gösterişlioğlu** *Senior Researcher, Melting Kinetics, Şişecam R&D Center, TR*
10:20 - 10:40	**Biopolymer Based Films Reinforced with Recycled SiO_2** **Dr. Timuçin Balkan** *Lead Sn. Researcher, Analytical Chemistry, Şişecam R&D Center, TR*
10:40 - 11:00	**Past and Future Developments in Phosphate Glass Laser Gain Material** **Owen McGann (ONLINE)** *Principal Technologist, Glass Technology Services Ltd, UK*
11:00 - 11:20	**LUNCH BREAK** FOYER A & FOYER B

PARALLEL SESSIONS	GREAT ROOM A ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II)
CHAIR	**ÖZGÜR ACAR** *Furnace Technologies Manager, Şişecam R&D, TR*
RESP. MEMBER	**EZGİ SÖZEN** *Researcher, Şişecam R&D, TR*
11:20 - 11:50	**Glass, Steel, Ceramics - Not as Different as We Appear** **Anne Jans Faber (INVITED)** *Research Fellow, Henry Royce Institute on behalf of Glass Futures, UK*
11:50 - 12:20	**Decarbonization of Glass Industry by Basalia's Technology** **Gürhan Dural** *Chief Project Officer, 7Cbasalia Global, TR*
12:20 - 12:40	**Photovoltaic Cell Deconstruction and Recovery** **Steve Whettingsteel** *CEO & Managing Director, Krysteline Technologies Ltd., UK*
12:40 - 13:00	**In 2023 the majority of end fired furnaces run on 20 minutes reversals! Why not optimise?** **Neil Simpson** *Consultant, Simpson Combustion and Energy Ltd., UK*
13:00 - 14:00	**LUNCH BREAK** THE CITY BRASSERIE

PARALLEL SESSIONS	GREAT ROOM B PRODUCT DESIGN (I)
CHAIR	**ALPER EMNİYETLİ** *Product and Brand Mang. Director, Şişecam Marketing, TR*
RESP. MEMBER	**OZAN ÖZALP** *Product Designer, Şişecam Design Center, TR*
11:20 - 11:50	**A New Emphasis on Research & Innovation to Drive Game-Changing Product Solutions** **Dr. David Kusuma (INVITED)** *Senator, World Design Organization, US*
11:50 - 12:20	**Sustainable Collaboration is The First Step of Creative Innovation and Design** **Sertaç Ersayın (INVITED)** *Treasurer, Board Member, World Design Organization, TR* *V. President, Industrial Designers Society of Türkiye, TR*
12:20 - 12:40	**Design Strategies in Glassware** **Değer Demircan Acılıoğlu** *Product Design Manager, Glassware, Şişecam Design Center, TR*
12:40 - 13:00	**Fundamentals of Ultra-Lightening in Glass Packaging** **Pelin Karabay** *Product Designer, Şişecam Design Center, TR*
13:00 - 14:00	**LUNCH BREAK** THE CITY BRASSERIE

PARALLEL SESSIONS	GREAT ROOM A FUNDAMENTALS OF GLASS SCIENCE
CHAIR	**ATİLLA ÇEBİ** *Analytic Support Services Director, Şişecam R&D, TR*
RESP. MEMBER	**CANER ASLAN** *Researcher, Şişecam R&D, TR*
14:00 - 14:30	**Atomistic Simulations of Glasses Fundamentals and Applications** **Prof. Dr. Jincheng Du (INVITED)** *Materials Science and Engineering, University of North Texas, US*
14:30 - 15:00	**How and Why Investigate the Structural Role of Elements in Glass and Liquid?** **Prof. Dr. Daniel R. Neuville (INVITED)** *Senior Research Director, IPGP – CNRS / Paris Institute of Earth Physics, FR*
15:00 - 15:20	**Natural Silicates in Fiberglass Production** **Dr. Hong LI (ONLINE)** *Fiber Glass, Nippon Electric Glass, US*
15:20 - 15:40	**Different Silica Sources and Their Effects on Melting and Foaming Behavior for E-Glass Production Alternative Silicate Sources** **Gülin Demirok** *Exec. Sn. Researcher, Melting Kinetics, Şişecam R&D Center, TR*
15:40 - 16:00	**Improvement of Selenium Retention and Selenium Coloring Process in Selenium-Containing Glasses** **Merve Kutluğ** *Head Sn. Researcher, Glass Specialities, Şişecam R&D Center, TR*
16:00 - 16:10	**CLOSING** GREAT ROOM A

PARALLEL SESSIONS	GREAT ROOM B PRODUCT DESIGN (II)
CHAIR	**YEŞİM GÜLENÇ** *Strategy Dev. & Portfolio Mng. Director, Şişecam, TR*
RESP. MEMBER	**SENA VELİOĞLU** *Product Designer, Şişecam Design Center, TR*
14:00 – 14:30	**Sustainable and Circular Design** **Rianne Koens (INVITED)** *Circular Design Consultant, Otura Design, NL*
14:30 – 15:00	**Fusion of Maestros** **Melike Altınışık (INVITED)** *Principal, Founder, Melike Altınışık Architects – MAA, TR*
15:00 – 15:20	**Sustainable Glazing Solutions** **Fatih Bahadıroğlu** *Portfolio Manager, Architectural Projects, Şişecam Marketing, TR*
15:20 – 15:40	**Development of the Methodology for Calculation and Analysis of Blank and Blow Mold Cooling System in Ansys Software Environment** **Yulii Aleksenko** *Design Analysis Engineer, Şişecam Moscow, RU*
15:40 – 16:00	**Sustainable Personal Care Product Packaging and System Solutions** **Umay Kara (ONLINE)** *Faculty Member, Industrial Design Department, Anadolu University, TR*
16:00 – 16:10	**CLOSING** GREAT ROOM A

ŞİŞECAM

38th INTERNATIONAL GLASS CONFERENCE

LOCATION OF ACTIVITIES

COLLABORATE 2 INNOVATE

FOR A SUSTAINABLE FUTURE

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SHERATON GRAND
ISTANBUL ATASEHIR


GREAT ROOM B
GREAT ROOM A
FOYER B
FOYER A

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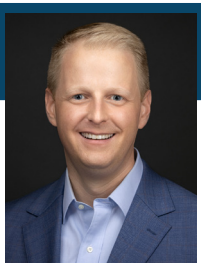
38th INTERNATIONAL GLASS CONFERENCE

PLENARY SPEAKERS

Dr. MILES BARR **(Keynote Speaker)**

Co-Founder and Chief Technology Officer
Ubiquitous Energy, United States



Session	PLENARY
Date	NOVEMBER 2, 2023, Thursday
Time	09:30 - 10:10 (Istanbul time, CET+02:00)
Chair	Dr. İLKAY SÖKMEN

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 Lem Elson-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

ERIK MUIJSENBERG (Keynote Speaker)
Vice President
Glass Service A.S., Czechia

Session	PLENARY
Date	NOVEMBER 2, 2023, Thursday
Time	10:40 - 11:20 (Istanbul time, CET+02:00)
Chair	Dr. İLKAY SÖKMEN

Decarbonization Pathway of the Glass Industry, Challenges, Opportunities for Different Segments and Possible Solutions Regarding Different Energy Inputs

Biography

Erik Muijsenberg is a Mechanical Engineering graduate of the University of Eindhoven from the Class of 1990. For the eight years following his graduation, he was employed by TNO Glass Group in Eindhoven focusing his efforts on furnace modeling and glass melting technology. In 1997 he became the TNO Glass Department leader.

In 1998 he became a GLASS SERVICE B.V. Managing Director, the first GLASS SERVICE subsidiary office in Maastricht, the Netherlands. After eleven years he moved to GLASS SERVICE headquarters in Czech Republic to become group Vice President. GLASS SERVICE employs over 100 engineers with offices worldwide including Czechia, Slovakia, Netherlands, Germany, UK, France, USA, China, and Japan. GLASS SERVICE daughter companies are well known worldwide as FlammaTec for combustion systems and FIC UK for Electric melting solutions.

In 1997 Erik was awarded the Otto Schott Award.

In 2012 he received the Adolf Dietzel Industry Award from the German Glass Society for his contribution to the development and acceptance of glass furnace modeling & optimization in the German glass industry.

He was chosen as a Fellow member by the British Glass Society in 2014.

Erik is also active Vice Chairman and past Chairman of the Technical Committee 21 – Furnace Design & Operations – of the International Commission on Glass (ICG).

As of 2016 Erik became an ICG Steering Committee member.

In 2017 he became a Phoenix Award Committee member. Since 2023 Erik is the Vice Chairman of the Phoenix Award Committee.

Erik has actively promoted Industry 4.0 smarter model based predictive furnace and forehearth control and CO_2 emission reductions to the Glass Industry for over twenty years.

ERIK MUIJSENBERG (Keynote Speaker)
Vice President
Glass Service A.S., Czechia

Session	PLENARY
Date	NOVEMBER 2, 2023, Thursday
Time	10:40 - 11:20 (Istanbul time, CET+02:00)
Chair	Dr. İLKAY SÖKMEN

Abstract

How can we reduce our carbon emissions with new furnace concepts and ideas? New ideas can only be safely developed and tested by using validated Computational Fluid Dynamics (CFD), such as GS Glass Furnace Model (GS GFM). It is quite logical that no glass producer will build a new furnace concept melting 100+ tons per day without thorough analysis, calculations and extensive CFD modeling. Lately, most glass producers are asking how to reduce carbon emissions with either increasing the amount of electric melting or hydrogen. We have seen in the past such intensive use of CFD modeling when the Oxy-fuel applications emerged. Now with the next generation of large Hybrid (with more than 50% electric boosting) or All Electric melters we can see an increase in demand once again.

The presentation will be divided into five parts:

1 The paper will show some history of (all) electric glass melting.

2 Important for carbon reduction and more electric or hydrogen melting is the availability of more renewable resources to create clean electricity. We will give an update about the worldwide developments in this field.

3 We will explain which technologies are more likely for the different segments, e.g., crystal and tableware, container glass, borosilicate, fiber glass and flat glass.

4 We will also show examples of some already existing large All Electric and large Hybrid melters. Some details of an operating large Hybrid melter will be shown in this presentation.

5 An important and often forgotten area is the forehearths; there is a large potential of 70-90% energy and thus carbon emission reduction potential to electrify the FH's.

Co-Authors

Johann Brunie, Society La Maison Francaise du Verre (LMVF), France
Christoph Jatzwauk, F.I.C., Germany

Keywords

hybrid furnace, all electric melting, CO2 reduction, energy audit, renewable energies

Prof. Dr. JOHN C. MAURO (Keynote Speaker)
Department of Materials Science and Engineering
The Pennsylvania State University, United States

Session	PLENARY
Date	NOVEMBER 2, 2023, Thursday
Time	11:20 – 12:10 (Istanbul time, CET+02:00)
Chair	Dr. İLKAY SÖKMEN

LionGlass: A Phosphate-Based Approach to Carbon-Neutral Glass Manufacturing

Biography

Dr. John C. Mauro is Dorothy Pate Enright Professor, and Associate Head for Graduate Education in the Department of Materials Science and Engineering at The Pennsylvania State University. John earned a B.S. in Glass Engineering Science (2001), B.A. in Computer Science (2001), and Ph.D. in Glass Science (2006), all from Alfred University. He joined Corning Incorporated in 1999 and served in multiple roles there, including Senior Research Manager of the Glass Research department. John is the inventor or co-inventor of several new glass compositions for Corning, including Corning Gorilla® Glass products. John joined the faculty at Penn State in 2017 and is currently a world-recognized expert in fundamental and applied glass science, statistical mechanics, computational and condensed matter physics, thermodynamics and kinetics, and the topology of disordered networks. John is the author of over 340 peer-reviewed publications and is the Editor-in-Chief of the Journal of the American Ceramic Society. He is co-author of Fundamentals of Inorganic Glasses, 3rd ed. (Elsevier, 2019), the definitive textbook on glass science and technology, and author of the newly published textbook, Materials Kinetics: Transport and Rate Phenomena (Elsevier, 2021). John is a Fellow of the National Academy of Inventors with 76 granted U.S. patents, John is also a Fellow of the American Ceramic Society and the Society of Glass Technology. He is a Member of the National Academy of Engineering.

Abstract

The global glass industry produces over 86 million tons of carbon dioxide annually. LionGlass is Penn State's patent-pending glass compositional family that offers, for the first time, an alternative to standard soda lime silicate glass, reducing the carbon footprint of the glass industry by >50%. LionGlass achieves this goal by lowering the melting temperature of everyday glass products by 400°C and eliminating the use of carbonate batch materials. LionGlass also offers 10× improvement in damage resistance compared to soda lime, enabling lightweighting of glass products.

Keywords

CO_2 reduction, sustainable glass production, lightweighting, damage resistance

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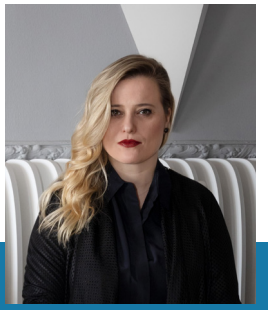
38th INTERNATIONAL GLASS CONFERENCE

INVITED SPEAKERS



MELİKE ALTINIŞIK

Founder

Melike Altınışık Architects - MAA, Türkiye

Melike Altınışık as an award-winning architect and designer, is dedicated to developing an innovative and visionary project towards architecture, urbanism and design. She leads her international architecture practice Melike Altınışık Architects- MAA with offices based in Istanbul, Turkey and in Seoul, South Korea.
MAA's work includes CTBUH 2022 "Best Tall Non-Building 2022" winning projects with advanced technology and innovation such as futuristic 369m supertall the Istanbul TV-Radio Tower in Istanbul, Turkey, and the world's first pioneering Robot and AI Museum (RAIM) in Seoul, South Korea.
Melike was awarded a Master of Architecture and Urbanism from the Architectural Association Design Research Laboratory (AADRL) in London in 2006 and graduated from Istanbul Technical University in 2003 with her High Honours. Prior to forming her own practice MAA Istanbul Office in 2013, she worked with Zaha Hadid Architects in London between 2006-2013.
Her training allows her to lead projects of varying scales from masterplans, high-rise buildings, and cultural centers to bespoke interiors, installations, and product designs, from initial concept to execution.
Her work has been commended with a number of awards including Europe 40 under 40, FEIDAD Design Award and Swiss Art Award, BAKSI 'Architecture Contribution Award' 2021.
She is also an international lecturer and sits on several international juries at various institutions such as Architectural Association (AA, London), Bartlett School of Architecture (UCL), Staedelschule of Architecture (SAC) and Istanbul Technical University (ITU).

Dr. YAKUP BAYRAM

CEO, Co-Founder

PaneraTech, Inc., United States

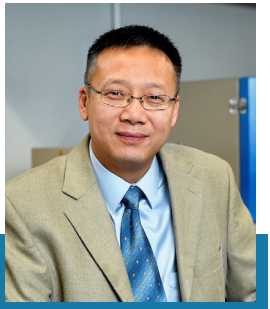
Dr. Yakup Bayram is CEO of PaneraTech. PaneraTech helps glass and steel manufacturers reliably make more product with their critical assets, even with a less-experienced workforce. PaneraTech's digital transformation of assets enables managers to make data-driven decisions by providing the threefold support of technology, data, and expertise. Prior to PaneraTech, Dr. Bayram has been the Principal Investigator and leading scientist on various radar-based sensors for asset health monitoring at The Ohio State University. Dr. Bayram and his team have been working with manufacturers for over two decades, developing innovative solutions for effective critical asset management. Dr. Bayram received his PhD in Electrical Engineering from The Ohio State University, specializing in advanced sensor solutions.

Dr. CALVIN CHENG

Chief Operating Officer and Co-Founder

Edgehog Advanced Technologies Inc., Canada

Dr. Calvin Cheng is Chief Operating Officer and Co-Founder at Edgehog Advanced Technologies Inc., an award-winning clean tech company in Canada. Calvin is a technology entrepreneur who also serves as President of the board of directors at Pueblo Science, promoting science education in low resource settings. Select awards including the CES Climate Change Innovation Award and Mitacs Outstanding Entrepreneur Award. He holds a Ph.D. in nanomaterials chemistry from the University of Toronto.



Prof. Dr. JINCHENG DU

Materials Science and Engineering

University of North Texas, United States

Dr. Jincheng Du is a professor of materials science and engineering at the University of North Texas, Denton, Texas USA. He obtained his Ph.D. on ceramic science from Alfred University and then did postdoctoral research at Pacific Northwest National Laboratory and University of Virginia before joining UNT as a faculty member in 2007. His research focus on atomistic simulations of structure, structure-property relation, functional applications, corrosion, and environment interactions of glass materials. He has published 2 books, 12 book chapters, and over 210 peer reviewed papers. As one of the leading experts in his field, he has given over 100 invited talks and seminars in international conferences and at universities around the world. Prof. Du currently serves as the Chair of TC27 atomistic modeling of International Commission of Glass (ICG) and Editor of the Journal of the American Ceramic Society. He is the past chair of the Glass and Optical Materials Division of the American Ceramic Society. Among other distinctions, he is an elected Fellow of the American Ceramic Society and American Society of Materials. He is also the recipient of the Research Leadership Award of UNT, Fulbright US Scholar Award, Gordon Fulcher Distinguished Scholar of Corning Inc., and the W.E.S Turner Award of ICG.

MEHMET VOLKAN DUMAN

Energy Manager, Manufacturing Industry Department

T.C. South Marmara Development Agency, Türkiye

Mehmet Volkan Duman has been working at South Marmara Development Agency since 2014, where he has devoted most of his practice to mining activities, advanced materials, defense industry, energy efficiency, renewable energy technologies, green hydrogen, recycle and reuse within the context of sustainable development. He has produced reports and strategy documents for these sectors, including relevant action plans. He has completed the evaluation and monitoring phase of more than 100 regional projects in these fields. In his career, a special emphasis should be placed on the green hydrogen economy. The first regional basic hydrogen roadmap in Türkiye was created by him and he has published several papers and reports on green hydrogen policies. In addition, he has participated as an invited speaker and has given many presentations in many organizations. Prior to 2014, he spent 7 years in the mining sector. Except his first job at one of the metal recycling plants, this was his first long-term professional experience. With this fresh start in mining sector, boron became the main element of his new career until the end of the year 2013. He worked at different production sites, so he became familiar with many different chemical processes. He had two main responsibilities at Eti Maden; he was the Head of Laboratory which had 50 workers, 1 chemist and 3 chemical engineers; and also, he was in charge of wastewater treatment plant used for boron removal from the base water of the open pit mines. The boron treatment plant is the first of its kind in Türkiye. He wrote a master's thesis on this facility and his articles were published in important journals. He earned many certificates for critical laboratory instruments among which XRF is one of the most crucial ones. He has three user certificates for three different brands of XRF instruments. And now; he is the project coordinator of Türkiye's first Hydrogen Valley Project and also, he is the project officer of a national project titled "South Marmara Hydrogen Shore Platform" in which Türkiye's first domestic green hydrogen pilot plant will be installed.

GÜRHAN DURAL

Chief Project Officer

7Cbasalia Global, Türkiye

Electrical Engineering degree from Istanbul Technical University and completed his MBA at Pirireis University. He joined Şişecam in 2003. Since 2014, he has been working at Şişecam Headquarters, taking part in the coordination of energy efficiency projects of all domestic and international factories, communication with legal authorities, and the coordination of the company's sustainability activities. Recently, he served as the Energy and Environmental Technologies Manager and as the Assistant General Manager for Research, Development and Quality. He joined 7Cbasalia Global Company in June 2022 as Chief Project Officer.

SERTAÇ ERSAYIN

Treasurer, Board Member, World Design Organization

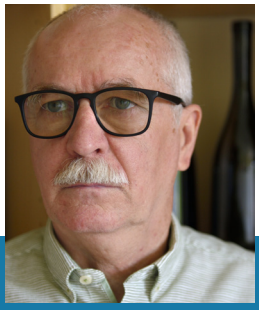
V. President, Industrial Designers Society of Türkiye, Türkiye

Sertaç Ersayın has been managing design initiatives for Turkey, these include various industries, NGOs, Societies, Local Municipalities and National Government projects. In the past 11 years, he organized several international design events in Turkey such as Design Turkey, Design Evaluation Systems for Ministry of Trade and Turkish Exports Assembly. He has been deeply engaged in integrating designers with the government and industry. These collaborations bring awareness about SDGs in Turkey through responsible production and consumption in various sectors. He has been involved in different industries in Design and Management responsibilities where ideas are assessed through the results of product and consumer experience and the returns of experiences from nearly +65 countries around the world.

ANNE JANS FABER

Research Fellowon behalf of Glass Futures, United Kingdom

AnneJans Faber finished his study Experimental Physics at Utrecht State University (NL) in 1985, cum laude. He started his career as project leader at the TNO Institute of Applied Physics in Delft in 1986. During the nineties he was leader of the group Glass Melting Technology of TNO Science and Industry in Eindhoven. From January 2012 to January 2021, he worked as senior scientist at CelSian Glass & Solar (former TNO Glass Group). He has written a large number of scientific publications, is holder of several patents and has been reviewer for international scientific journals. In 1997 he received, together with 3 colleagues of TNO, the prestigious Otto Schott Research Award for applied and fundamental research in the area of glass technology and glassy materials. In 2005 he received the Descartes-Huygens prize from the French Government and French Academy of Sciences for his contribution to the scientific cooperation between France and The Netherlands, especially in the domain of innovation. In June 2012 he received the German Industry prize (Adolf Dietzel Industriepreis) from the German Glass Society (Deutsche Glastechnische Gesellschaft). During his career at TNO and CelSian he acted as senior scientist and technology innovation consultant for industrial companies in Europe, the US and Asia. He organised industrial R&D consortia and workshops and he presented Glass Science & Technology training courses for international glass companies in the framework of the organisation Glass Trend. Currently he is scientific consultant at Physica Fit Faber and Research Fellow at Henry Royce Institute, Manchester, supported by Glass Futures, UK. In these roles he focuses on the technological challenges of low carbon glass production.



Dr. MARIAN KLISCH

Head of R&D

Forglass Sp. z o.o., Poland

Marian Klisch was born on 22 August 1955 in Zary in western Poland. In 1979 he graduated from AGH University of Science & Technology in Krakow. In 1989 he received a PhD in chemical technology from the same university. During his over 40-year professional career, he worked at a glass research institute, university and glassworks producing tableware, where he was the technical director. Since 2017, he has been associated with Forglass, where he is the director of research and development. He is the author and co-author of many patents in such distant areas as electrochromic coatings on glass, biomaterials, glass-to-metal and glass-stone macrocomposites, refractory materials, granulation of glass batches, glass furnace and glass melting and of course mixing electrode.

RIANNE KOENS

Circular Design

Otura Design, Netherlands

Rianne Koens graduated cum laude from the Design Academy Eindhoven in 2011. Her graduation projects got awarded and nominated. Thanks to this success she launched the design label Otura in 2012. As all her work is inspired by the Turkish culture she's active from Istanbul since 2013. Ever since she designs for the Otura collection and international brands. Three years ago, Koens made a career switch from design to circular design consultant.

Dr. DAVID KUSUMA

Senator

World Design Organization, United States

David Kusuma is President of the World Design Organization (WDO) for the 2022-2023 term. He has led design and product innovation for major multinational companies as Senior Vice President at Oregon Tool Inc., Global Vice President of R&D and Product Development at Tupperware Brands Corporation, and Global Manager of Design & Vehicle Engineering at General Electric. His work at Tupperware created game-changing product solutions, leading to the development of 150 to 200 new products every year and launched in over 100 countries around the world. He was also responsible for developing the PONDS plant growing system in collaboration with NASA, designed by Tupperware to simplify growing vegetables in microgravity, and now being used onboard the International Space Station (ISS). David Kusuma also worked at Bayer Material Science. He is recognized as a Fellow of the Industrial Designers Society of America (IDSA), and a Fellow of the Society of Plastics Engineers (SPE).

OZAN NALCIOĞLU

Vehicle Hardware Systems Engineering Lead, Engineering and Technology Development

Ford Otosan, Türkiye

Ozan Nalcıoğlu graduated from Istanbul Technical University with MSc in Mechanical Engineering in 1996 and joined Ford Otosan in 1998 as product development engineer. He served in a variety of leadership positions and product projects (Ford Transit, Connect, Courier, Cargo, Fmax, Ranger vehicles and Ecotorq, Duratorq engines) during the growth of the team as Turkey's largest product development organization in automotive.
He is currently leading Vehicle Hardware Engineering and is champion on Ford Otosan Carbon Transition Program.

Prof. Dr. DANIEL R. NEUVILLE

Geomaterials Specialist, Paris Institute of Earth Physics

IPGP – CNRS / Institute of Earth Physics, France

Daniel R. Neuville obtained his PhD in Geochemistry (University Paris Diderot, IPGP) in 1992. Since 2014; he is the head of the Geomatériaux group of IPGP. Since 2013, he is in charge of the Master of Geochemistry, geomaterial, geobiology and environement program of Université de Paris Cité. He was secretary of the French Mineralogical and Cristallography Society, between 1994 and 2009. He has organized several international workshops and schools and convened many sessions at international meetings, such as EGU, Goldschmidt, IMA, AGU, GOMD. In 1999, he obtained the Jean Rose Price by the French Association of Science and in 2007-2008, he was Joubin-James Invited professor at University of Toronto. He was elected fellow of the American Mineralogical society in 2018 and he received the Otto Schott research Award from Ernst Abbe Fund in 2022.
Since 2007, he is Editor of the amorphous material issues of the American Mineralogist; Guest Editor for Elements, vol. 6 (2010), "Thermodynamics: the oldest branch of earth science", and vol. 16 (2020) "The redox engine of the Earth" and Review in Mineralogy and Geochemistry, vol. 78 (2014) "Spectroscopic methods in Mineralogy and Material Sciences", and vol. 87 (2022) "Geological Melts" and for American Geophysical Union Monography on "Magma Redox Geochemistry"(2021).
In 2012, he was elected president of the French glass society (USTV), and relected in 2015 and 2018. Since 2013, he is elected Chair of the TC3 Committee of the structure and properties of glass of the International Commision on Glass. He was the elected chair of the commission of Mineral Physics of the International Mineralogical Association (2014-2022).
He has published more than 210 international articles, and given more than 400 presentations at international congresses, more than 60 invited conferences.

Dr. BONNA NEWMAN

Head of Solar Products

Lightyear, Netherlands

With almost two decades of experience in research across the solar PV module value chain, including materials, cell modelling, novel substrates, light management, and cell-to-module process integration, most recently as portfolio manager for Circularity and Module Manufacturing Technologies at the Netherlands Organization for Applied Scientific Research (TNO), Bonna Newman, is Head of Solar Products at Lightyear, the Dutch startup developing solar electric vehicles. She has a PhD in atomic physics from the Massachusetts Institute of Technology and was the recipient of the Clare Boothe Luce Postdoctoral Fellowship. In 2021, she founded the Alliance for Solar Mobility (asom. solar), an industry alliance that represents more than 25 companies involved in the VIPV supply chain. She is also a member of the steering committee for the European Technology and Innovation Platform for PV (ETIP-PV) where she chairs the working group on Integrated PV Applications.

THOMAS PREUßNER

Deputy Group Leader, S2S Sputtering&PECVD

Fraunhofer FEP, Germany

Thomas PREUßNER received a degree in Dipl.-Ing. (FH) at the University of Applied Sciences Zwickau, Germany in 2006. Since 2006 he is working at the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP. Presently, he is deputy group leader of the S2S Sputtering & PECVD group. Dealing with several research topics related to thin film deposition, he has a deep background in thin film deposition processes, process hardware and thin film analysis. His main research interests are the development of sputtering and PECVD processes as well as the post-treatment of films by flash lamp annealing / photonic curing.

TAIGA SEKI

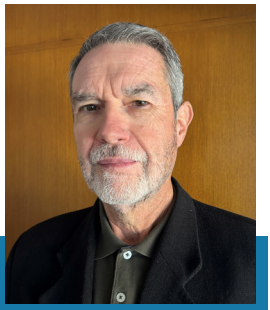
Manager of Innovative Technology Laboratory
AGC Inc., Japan

Taiga Seki received both BS and MS degrees in Mechanical Engineering, from Keio University. His expertise is IN research and development on glass melting process with a focus on numerical simulation techniques.
Seki is working as the Manager of Innovative Technology Laboratory at AGC Inc. He has a decade of experience in CFD modelling and the development of numerical simulation techniques for glass furnaces and is qualified as a Grade 1 JSME-Certified Computational Mechanics Engineer in the field of Thermal Fluid Mechanics. In recent years his work has focused on the development of digital twin technology for glass furnaces.

Prof. Dr. YUANZHENG YUE

Department of Chemistry and Bioscience
Aalborg University, Denmark

Yuanzheng Yue is Professor of Chemistry at Aalborg University (AAU), Denmark. In 1995, he obtained his Ph.D. degree in Materials Science from Technische Universität Berlin. Following that, he has been working in academia and industry in Europe. In 1998, he established the inorganic glass research field at Aalborg University. His research focuses on glasses, glass fibers, and amorphous materials. He has published over 380 peer-reviewed papers in international journals including Nature and Science. He has given over 130 invited talks at conferences.
He is an elected Fellow of the European Academy of Sciences, the Royal Society of Chemistry, the European Ceramic Society, and the Society of Glass Technology (UK). He is an elected member of the Danish Academy of Natural Sciences. He holds Knight's Cross of the Order of the Dannebrog (Denmark). He is a council member of the International Commission on Glass (ICG) and the chair of the ICG Technical Committee for Glass Fibers. He serves as an editor for the European Journal of Glass Science and Technology, as well as an associate editor or editorial member for six other international journals.



Prof. Dr. EDGAR DUTRA ZANOTTO

Materials Science and Engineering,
UFSCar - Federal University of São Carlos
Director of the Center for Research, Tech. and Education in Vitreous Materials, Brazil

Edgar Dutra Zanotto (EDZ) has been a professor at the Federal University of São Carlos, Brazil, since December 1976. He has also been serving as an editor of Elsevier's Journal of Non-Crystalline Solids since 2010. In the past 46 years, Professor Zanotto had dozens of research contracts and consulting agreements with funding agencies and glass industries. His main expertise refers to glass science topics on dynamic processes (viscous flow, diffusion, relaxation, crystallization) and properties of glasses and glass-ceramics. In the past 5 years he became interested in the use of Artificial Intelligence approaches to understand and develop novel glasses with property combinations. As a result of his research work, EDZ has published over 400 original and review papers, 25 book chapters, 3 books, 5 book prefaces, 27 filled patents with his students and collaborators, and advised 95 theses and postdocs. As regards glass crystallization, he is the most prolific at Scopus with the keywords "crystal, nucleation, and glass". EDZ has received 59 science awards from various organizations around the world. His awards include 7 of the most important international glass research awards and distinctions (Zachariasen Award, Gottardi Prize, Morey Award, Foster Research Prize; Turner, Cooper, and Scholes Lecturer), and the Zanotto Award created by MRS India. He is a member of 5 science academies and a Fellow of the ACerS, SGT, and the Brazilian Ceramic Society.

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38th INTERNATIONAL GLASS CONFERENCE

ORAL PRESENTATIONS

COLLABORATE 2 INNOVATE

FOR A SUSTAINABLE FUTURE

2-3 NOV 2023

SHERATON GRAND
ISTANBUL ATASEHIR

ŞİŞECAM

38th INTERNATIONAL GLASS CONFERENCE

ADVANCED MATERIALS AND DEVICES

COLLABORATE 2 INNOVATE

FOR A SUSTAINABLE FUTURE

2-3 NOV 2023

SHERATON GRAND
ISTANBUL ATASEHIR

OZAN NALCIOĞLU **(Invited Speaker)**
Ford Otosan, Türkiye

Session	ADVANCED MATERIALS AND DEVICES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	15:20 - 15:50 (Istanbul time, CET+02:00)
Chair	MURAT ARDIÇ YILMAZ

The Future of Automotive Glazing

Abstract

The automotive industry is under pressure to become more sustainable and to integrate intelligent devices, in response to developing consumer demands and new legislation.

It is imperative that we take the lead in initiatives such as the widespread implementation of autonomous vehicles and electrification, which are fundamentally changing our sector and generating solutions that enhance the lives of our customers. During this transformation, we will present our plan to tackle the upcoming challenges in the automotive glass industry by utilizing innovative material technologies. Additionally, we will provide insights into how the appearance of car glass will evolve in the future.

Keywords

advanced glass technologies, nano technology applications, automotive glass innovations, connectivity

Dr. BONNA NEWMAN **(Invited Speaker)**
Lightyear / ASOM Alliance for Solar Mobility, Netherlands

Session	ADVANCED MATERIALS AND DEVICES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	15:50 - 16:20 (Istanbul time, CET+02:00)
Chair	MURAT ARDIÇ YILMAZ

Opportunities and Challenges for VIPV

Abstract

Vehicle integrated PV is an emerging multi-GW PV global market where on-board PV delivers energy from the sun directly to electric vehicle power trains and auxiliary systems. While the concept has been around for more than 50 years, developments in the cost and availability of high performance and reliable solar technology combined with the growing EV market are ensuring that solar-powered vehicles will be a standard market offering by 2030. In this talk, I will share updates on the recent technical progress toward integrating PV into passenger car bodies, heavy transport and many other kinds of transportation options both safely and effectively. In addition, I will address the larger technical and regulatory framework that is developing to support these technologies and the role they will play in the energy transition.

Keywords

PV module, vehicle integrated PV, energy transition

STEPHANE BALDO
SYNERGX Technologies, Canada

Session	ADVANCED MATERIALS AND DEVICES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	16:20 - 16:40 (Istanbul time, CET+02:00)
Chair	MURAT ARDIÇ YILMAZ

Virtualization of Optical Qualification for Windshield Camera Zones

Abstract

Windshields are not neutral optical elements. They can have an important negative impact on the performance of ADAS and AD systems. Different makers of these systems specify various quality requirements and different quality metrics validation for the need of their specific systems. These metrics are such as optical power, MTF, wavefront analysis, etc. The plurality of these tests would impose an unbearable burden on windshields makers in terms of investment and in terms of impact on production throughput by their time-consuming chokehold if using conventional measuring technics. We have developed a new scanning technology that mathematically models in high definition and high precision the inner and outer surfaces of the camera zone. Using this representation, we can virtualize any optical test by advanced ray tracing rendering: Optical power at any tilt and yaw angles, multi position MTF measurement, shack-Hartmann full surface sensor, full surface mapping of double image, maximum stereoscopic deviations. This all-purpose representation can also be integrated by ADAS and AD systems makers into their calibration process, their QC pipeline, and their teaching database for system robustness improvements.

Keywords

scanning technology, windshields, automotive; ADAS, AD

UTKU ER[1,2], Alpan Bek[2], Seniz Türküz[1]
1 Sisecam R&D Center, Türkiye
2 Middle East Technical University, Ankara, Türkiye

Session	ADVANCED MATERIALS AND DEVICES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	16:40 - 17:00 (Istanbul time, CET+02:00)
Chair	MURAT ARDIÇ YILMAZ

Developing of Transparent Radar Absorber Surfaces

Abstract

Military platforms should be low observable systems because of the RF stealthiness. Radar absorbing materials or structures play a key role in the design of such stealth military platforms. Organic radar absorbing materials are not transparent in visible regions, therefore they can be used only at non-transparent regions of military systems. Absorption ability in long wavelength electromagnetic waves is also required at transparent materials in military systems (glass, polycarbonate, acrylic etc.) By different applications on these transparent surfaces, it is possible to make these surfaces absorber in microwave and radio frequency (RF) region of electromagnetic spectrum. In this work, radar absorber surfaces were designed and produced by TCO containing multi-layer structures in 10x10 cm2 areas which are not only an absorber at 12-18 GHz bandwidth but also transparent in visible region. When all the results were examined, a 98% absorber and 76% optical transmissive sample was obtained across the wide band in the 12-18 GHz range. Moreover, structures provide IR blocking and do not allow in-vehicle imaging with IR detectors. All samples and results obtained by this study are candidates for commercialization in terms of ease of transfer to large area.

Keywords

radar absorption, TCO thin films, visible transparency, multi-layer structures

BEYZA YEDİKARDEŞ ER[1-2], Mustafa Altun[2], Esra Zayim[2]
[1] Şişecam R&D Center, Turkey
[2] Istanbul Technical University, Turkey

Session	ADVANCED MATERIALS AND DEVICES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	17:00 - 17:20 (Istanbul time, CET+02:00)
Chair	MURAT ARDIÇ YILMAZ

Developing P_3HT: WO_3 Hybrid Thin Films for Applications in Solid State Electrochromic Devices

Abstract

Although poly(3-hexylthiophene) (P_3HT) is a promising p-type conjugating polymer to optimize optical and electrical properties, it is known to be chemically unstable. To overcome this unstability, P_3HT was doped with WO3 to produce hybrid thin films. Different amounts of WO_3 were added into the P_3HT solution and structural characterizations were done by scanning electron microscopy, atomic force microscopy, and photoluminescence spectroscopy. The electrochemical reactions were studied by cyclic voltammetry and by electrochemical impedance spectroscopy. With the increase amount of WO_3 in P_3HT, the electrochromic efficiency increases first and then decreases. The optimum concentration was found as 30 wt% of WO_3. Almost 110% increase in coloration efficiency (from 220 cm^2/C to 464 cm^2/C) was achieved for WO_3 doped thin films compared to P_3HT and long cycle device stability was significantly improved. Moreover, capacitive properties of P_3HT were developed with WO_3 doping. Structural and electrochemical investigations suggest that the optimum doping of P_3HT with WO_3 can facilitate the development of electrochromic energy storage applications in the near future.

Keywords

P_3HT, WO_3, electrochromic, organic - inorganic hybrid thin films

Prof. Dr. EDGAR D. ZANOTTO **(Invited Speaker)**
Federal University of São Carlos, Brazil

Session	ADVANCED MATERIALS AND DEVICES (II)
Date	NOVEMBER 3, 2023, Friday
Time	09:00 - 09:30 (Istanbul time, CET+02:00)
Chair	Dr. BURCU APAK

Glass-ceramics: Marvels with a Few Problems

Abstract

The first glass-ceramic (GC) is 70 years old; they were "accidentally" discovered by S.D. Stookey in 1953. Glass-ceramics are inorganic, non-metallic materials prepared by controlled crystallization of glasses via different processing methods. They contain at least one type of functional crystalline phase and a residual glass. The volume fraction crystallized may vary from ppm to almost 100%. Glass-ceramics comprise a noteworthy class of unique materials that can deliver unusual property combinations, such as extremely low thermal expansion coefficient; optical transparency or translucency; high stiffness, hardness, fracture strength, and toughness; high or low electrical conductivity; bioactive behavior; controlled chemical durability and superior aesthetics. From a scientific perspective, they are ideal materials for controlling and studying nano- or micro-structure/property relationships. From a technological standpoint, glass-ceramics' wide range of valuable properties renders them perfect choices for sophisticated domestic and high-tech applications.

In this talk we will review some of GCs most valuable properties and applications, such as transparent cooking ware, cooktop plates, telescope mirrors, cell phone screens, hard disk substrates, photo-thermo refractive gratings, dental prostheses, bioactive materials for bone replacement, nuclear waste disposal hosts, and artificial stones for architecture. Finally, we will also dwell on some complications regarding their synthesis, such as crystallization-triggered bubbles, spontaneous cracking, and microstructural gradients, as well as possible solutions for these problems.

Keywords

glass, crystal, glass-ceramics, crystallization, applications

Prof. Dr. YUANZHENG YUE **(Invited Speaker)**
Aalborg University, Denmark

Session	ADVANCED MATERIALS AND DEVICES (II)
Date	NOVEMBER 3, 2023, Friday
Time	09:30 -10:00 (Istanbul time, CET+02:00)
Chair	Dr. BURCU APAK

Current Understanding of the Properties and Formation of Glass Fibers

Abstract

Glass fibers play a crucial role in various modern technologies, including fiber lasers, fiber communications, fiber-reinforced composites, and thermal and acoustic insulation. However, there is still ample opportunity to optimize the production process and enhance the performance of glass fibers, contributing to a more sustainable society. In this presentation, I will discuss our current understanding of the structure-property relationship and the mechanisms involved in glass fiber formation. Furthermore, I will outline the challenges we face and provide insights into the development of high-performance glass fibers for environmentally friendly production and applications, aligned with our vision for a sustainable future. Specifically, I will focus on inorganic fibers, emphasizing their role in composite reinforcement and thermal insulation. Additionally, I will touch upon the quantification of glass fiber spinnability.

Keywords

glass fibers, composites, reinforcement, sustainability, insulation, spinnability

YEKTA ATEŞ GÖSTERİŞLİOĞLU
Duygu Güldiren, Nahide Özben, Süleyman Görpinar, Ayşe Özgür
Şişecam R&D Center, Türkiye

Session	ADVANCED MATERIALS AND DEVICES (II)
Date	NOVEMBER 3, 2023, Friday
Time	10:00 - 10:20 (Istanbul time, CET+02:00)
Chair	Dr. BURCU APAK

Composition Optimization for Improved Chemical Durability on Crystalline Glassware Products

Abstract

Life span is one of the major key expectations from glassware products which might be restricted by composition dependent chemical resistance. Repeated dishwashing cycles under corrosive environment requires glass composition to be chemically more durable for extended product satisfaction. A complex methodology was followed for optimizing the chemical composition of glassware products for higher chemical resistance while preserving the batch cost, melting energy, forming temperature range and especially the crystalline glass properties dictated by the directive 69/493/EEC. Empirical models for predicting glass properties and benchmark data were utilized as well as prototype manufacturing and conducting tests & characterizations during composition optimization studies. Effect of chemical composition on the glass properties and chemical durability for glassware products are presented and explained for an optimized glassware composition.

Keywords

crystalline, glass composition, chemical durability

Mehmet Berkecan ÇAKIR[1], Burak İZMİRLİOĞLU[2], Pelin AKKAYA[2], **TİMUÇİN BALKAN[2*]**, Merve MOCAN[1*]
[1]*Gebze Technical University, Türkiye* [2]*Şişecam R&D Center, Türkiye*

Session	ADVANCED MATERIALS AND DEVICES (II)
Date	NOVEMBER 3, 2023, Friday
Time	10:20 - 10:40 (Istanbul time, CET+02:00)
Chair	Dr. BURCU APAK

Biopolymer Based Films Reinforced with Recycled SiO_2

Abstract

Glass is a recyclable material, however, feeding fine particles of glass cullet back into the furnace for recycling seems impractical due to the potential for bubble formation, foaming and negative impacts on refractories [1]. As our knowledge, 4000 tons of fine cullet are outcome annually within Şişecam. Since the fine cullet contains approximately 65-70% SiO_2 by mass, the recovery of SiO_2 is crucial. Plastics are extensively used in the packaging sector, driven by their flexibility, strength, light-weightness and stability. However, the increasing global concern about plastic pollution, especially microplastics, highlights the urgent need for proper waste management to safeguard the environment and marine life. Biodegradable packaging films can be a practical solution to tackle these problems. Recycled SiO_2 can be offered as a reinforcing material in packaging films resulting in improving their properties, such as tensile strength, thermal stability, and water-vapor barrier.

In this study, composite films based on biodegradable and bio-based pectin-alginate were prepared, incorporating varying concentrations of SiO_2 (0-5% w/w). SiO_2 powders were recovered using alkaline digestion of fine cullet. XRF results of the recovered SiO_2 showed that its purity was almost 99%. Morphological analysis and structural evaluation of films were carried out via scanning electron microscopy (SEM) and Frourier-transform infrared spectroscopy (FTIR) respectively. The optimum SiO_2 ratio was determined by measuring the thermal, mechanical and barrier properties of the prepared films by using thermal gravimetrical analyzer, universal testing machine and water permeability measurements. Consequently, using SiO_2 as a reinforcing agent in composite films provides a simple and effective approach to enhancing the properties of biopolymer-based films, especially in packaging applications. Additionally, it offers an alternative solution to mitigate environmental pollution by employing bio-based and biodegradable packaging films and by valorizing waste materials.

Notes

This study forms a part of the research program of TÜBİTAK project number: 221O135.

References

[1] Deng, W., Wright, R., Boden-Hook, C., & Bingham, P. A. (2018). Briquetting of waste glass cullet fine particles for energy saving glass manufacture. Glass Technology-European Journal of Glass Science and Technology Part A, 59(3), 81-91.

Keywords

recovery, fine cullet, biopolymer, composite

OWEN MCGANN
Glass Technology Services Ltd, United Kingdom

Session	ADVANCED MATERIALS AND DEVICES (II)
Date	NOVEMBER 3, 2023, Friday
Time	10:40 - 11:00 (Istanbul time, CET+02:00)
Chair	Dr. BURCU APAK

Past and Future Developments in Phosphate Glass Laser Gain Material

Abstract

Phosphate glass has found wide use in the area of photonics over the past 20 years, chiefly owing to the solubility of rare-earth elements in phosphate glass which are key to the photonic processes involved in laser amplification. These materials have found their use in a wide range of laser devices, from small scale DPSS devices for sensing, to communications devices and even to the very high energy lasers utilized in inertially confined fusion experiments. Despite this no more than a dozen organizations internationally possess the capability to manacture this material. This talk will provide an overview of the advantages and challenges posed in the use of glass materials, and phosphate glasses in particular, for laser gain material. The specific challenges related to the production of these materials will be discussed, with an analysis of their potential solutions. Glass Technology Services Ltd has been working in phosphate photonic glass materials for more than a decade and now commercially manufactures these glasses. This talk will share the work undertaken by GTS over this period in the development of gain material for_ 1.5µm Q-switched laser systems including the development of 'athermal' glass compositions, and in the development of novel gain materials for use in mode-locked laser systems, with a view to the specific challenges posed by operation at ultra-fast pulse durations such as damage arising from non-linear absorption. Lastly the talk will provide an overview of the opportunities that phosphate laser gain, and wider phosphate optical and photonic glass materials may offer for future technological development.

Keywords

glass, phosphate, laser, gain, material

Dr. YAKUP BAYRAM **(Invited Speaker)**
PaneraTech, Inc., United States

Session	DIGITALIZATION
Date	NOVEMBER 3, 2023, Friday
Time	09:00 - 09:30 (Istanbul time, CET+02:00)
Chair	ESRA YAZICI

Bridging the Generation Gap with Data-Driven Processes

Abstract

The glass industry is experiencing the collision of two major changes. First, an increase in the cost of capital due to rising interest rates has made the optimization of assets a high priority. Second, the experienced managers who oversee asset optimization are retiring away, leaving furnaces in the hands of a younger, less-experienced workforce. One issue compounds the effect of the other.

One solution to this problem is digitization for data-driven decision making using Artificial Intelligence (AI). However, approximately 75% of AI algorithms never make it to production. This is often because the proper steps were not taken, or important steps were missed in the process.

This presentation will outline the five steps to digital transformation: The first step is to collect data using advanced sensors. Next, a platform needs to be provided for visibility and analyzation of that data. Once the data is available, the next step is to provide transparency across the organization so that stakeholders can understand what the data means and why certain things are happening. A very crucial step that is often missed is to build a data-driven culture in the organization so that everyone is comfortable with the use of data and this kind of decision-making is a normal part of day-to-day operations. Only after all of these steps have been taken can AI algorithms be successfully established.

Dr. Bayram will demonstrate how PaneraTech is helping glass manufacturers walk through the process of digital transformation to help bridge the generation gap and promote successful furnace life optimization.

Keywords

data-driven decision, digitalization, artificial intelligence, glass manufacture, furnace, digital transformation

TAIGA SEKI (Invited Speaker)
AGC Inc., Japan

Session	DIGITALIZATION
Date	NOVEMBER 3, 2023, Friday
Time	09:30 - 10:00 (Istanbul time, CET+02:00)
Chair	ESRA YAZICI

Challenges toward Furnace Digital Twin

Abstract

Controlling flow of liquidus glass melt inside the furnace is one of the key factors to achieve mass production of high-quality glass products. To optimize the design and operations of glass manufacturing process, CFD has been widely used.

The recent concept of Digital Twin is a promising technology also for glass industry. Further optimization of the process operation and predictive maintenance can be expected using detailed real-time insights obtained by DT.
AGC has developed digital twin technology for the glass melting process that integrates an online simulator with a digital prototyping tool. Full-scale operational verification at actual float furnaces begun in 2023, confirming that digital twin enables rapid and detailed understanding of the glass melting process and preliminary studies of furnace operations.

As the next step, AGC is working on improvement of accuarcy and reliability of the digital twin using a technique called "Data Assimilation. Data assimilation is known as a sequential method to estimate both state of the system and the model parameters simultaneously, which has been widely used in weather forecasting. In the present study, we applied data assimilation method to the CFD model for continuous glass melting process to implement DT. From preliminary observing system simulation experiment (OSSE) studies, several model parameters, temperature distribution and flow pattern of glass melt were successfully estimated by ensemble kalman filter (EnKF) using temperature data which are measurable in reality.

References

[1] *A. Rasheed, O. San, and T. Kvamsdal. Digital twin: Values, challenges, and enablers from a modeling perspective. IEEE Access, Vol 8, pp. 21980-22012, 2020.*

[2] *J. J. Ruiz, M. Pulido, T. Miyoshi. Estimating model parameters with ensemble-based data assimilation: A review, Journal of the Meteorological Society of Japan. Ser. II, Vol. 91(2), pp. 79-99, 2013.*

Keywords

digital twin, CFD, data assimilation

İBRAHİM ŞAHİNOĞLU
Şişecam IT, Türkiye

Session	DIGITALIZATION
Date	NOVEMBER 3, 2023, Friday
Time	10:00 - 10:20 (Istanbul time, CET+02:00)
Chair	ESRA YAZICI

Şişecam Digitalization Through the Looking Glass of Big Data and Data Analytics

Abstract

Digitalization journey requires many steps to be completed throughout all the processes of manufacturing. With the goals of data transparency, deep analysis, repeatable solutions, and the goal of Dark Factory, we analyze steps and technologies in this journey.

One can't comment on what one doesn't know. Analysis starts with making the data available and accessible with ease. Before launching a rocket into space, we need to be able to work on the basics of data analysis. "Decision support systems" term was coined back in 60s-70s, and Data Warehouse was being discussed at the 70s. Through different shapes and forms, we still need to start with this well-known idea.

With modern times, building analytics systems adapted to using modern technologies. We now use "cloud" to store and process our data, machine learning to find questions we don't know to ask. We have digital bots and assistants to guide us through this data. Now, cars drive themselves, or do they? At this point, we discuss points like how CAPCTHA is used to train AI, we try to demystify all the marketing terms and we find the solid ground within all this, keeping in mind that imagination drives innovation.

We discuss Şişecam Data Analytics strategies; Big Data architecture/pipelines and self-service analysis, Digital Twins and Industrial IoT, data driven/physics driven models, how we fit in the Data World, the way forward and future of an all-connected manufacturing.

Keywords

digitalization, bigdata, IIoT, AI/ML, digital twin

CAN DANIŞMAN
VSight UAB, Türkiye

Session	DIGITALIZATION
Date	NOVEMBER 3, 2023, Friday
Time	10:20 - 10:40 (Istanbul time, CET+02:00)
Chair	ESRA YAZICI

VSight - Remote Collaboration and Knowledge Platform

Abstract

Shortage of skilled labor and knowledge gap is an increasing problem for industrial companies to maintain operations up and running. It is crucial more than ever to share and leverage existing knowledge and expertise across organizations and teams. Our mission is to help industrial businesses build a digital knowledge network and empower the workforce by enhancing their access to know-how and remote expertise whenever they need; hence increasing operational efficiency. Founded with this mission in 2019, VSight has been offering the best-in-class B2B SaaS remote collaboration and digital workflow solutions to industrial companies with its all-in-one Augmented Reality Platform. VSight Remote allows field technicians to connect and collaborate remotely (powered by AR) wherever and whenever they need assistance or training, instantly. VSight Workflow enables self-guided, step-by-step work instruction assistance for onsite technicians with Interactive Digital Instructions, Workflows & Checklists to streamline your operations with higher work accuracy and safety. Our platform helps crucial operations like service, maintenance, inspecting, training and quality assurance with many benefits regarding productivity and efficiency such as; Reduced Costs & Travelling to Provide Service Expert Support Faster Troubleshooting Reduced Losses due to Machine Downtime Increased Workforce Productivity Digitalized Paper-Based Instructions Higher Customer Satisfaction and Loyalty Currently, VSight is active in various manufacturing-related industries world-wide helping companies to solve complex manufacturing problems and boosting industrial operations and customer experience. With this presentation, we would like to further introduce VSight as a company with its platform, talk about our active use-cases from different industries, also focusing on the benefits of VSight for the glass manufacturing industry, by referring to our customers world-wide.

Keywords

remote assistance, smart glasses, augmented reality, maintenance, field service, quality

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[1]*Koç University, Türkiye* [2]*Turkish Petroleum Refineries Corporation, Türkiye*

Session	DIGITALIZATION
Date	NOVEMBER 3, 2023, Friday
Time	10:40 - 11:00 (Istanbul time, CET+02:00)
Chair	ESRA YAZICI

Machine Learning Based Modeling of an Industrial Thermal Cracking Furnace

Abstract

Thermal cracking process of heavy residue hydrocarbons occurs under severe thermal conditions. The visbreaking is mild heating to crack the residue, thereby reducing the viscosity while producing lighter products. Thermal cracking reactions are quite endothermic and necessitate excessive heat which can be supplied by furnaces or produced coke. This coke is deposited on the walls of the furnace, which in turn leads to an increase in the tube wall temperatures. Hence, coke formation is a critical problem in terms of reaction/operation efficiency. Accordingly, monitoring the temperature changes of the tubes in the furnace, showing the direct correlation with the coke deposition, is vital for optimal cracking efficiency and predictive maintenance. Machine learning methods can capture the distinctive characteristics of a system without any prior knowledge of the process given enough actual data. Accordingly, data-based modeling for the visbreaker unit is a promising study using actual temperature and maintenance process data set and various machine learning methods. In this study, recurrent machine learning algorithms such as RNN and LSTM are utilized to predict the process conditions, specifically the furnace coil temperatures, of the visbreaker unit. The dataset contains the average daily furnace coil temperature values covering the years. The best validation results were obtained by using a timestamp value of 10, which is several days to predict the 11th day of the operation. The test means absolute error was calculated as 7°C with the RNN model, which was used to predict the future days wall temperature, and 18°C in the LSTM method. Being able to predict the temperatures of the future days by using the temperature value of the past days gives information about the coking amount of the furnace and how long it will remain in operation. With this information, decision support that maximizes plant operability and profit can be provided.

Keywords

machine learning, data-driven, digitalization

MEHMET VOLKAN DUMAN **(Invited Speaker)**
South Marmara Development Agency, Türkiye

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	15:20 - 15:50 (Istanbul time, CET+02:00)
Chair	SERKAN ŞAHİN

Hydrogen Economy in Türkiye & South Marmara Hydrogen Shore-HYSouthMarmara

Abstract

The European Union and its members have been taking bold steps on clean hydrogen over the last few years. Electrolyzer capacities are increasing along with renewable energy investments. These new investments are supported by various national and Union support mechanisms. Türkiye should set a clear vision in order not to fall behind this green transformation and, more importantly, to eliminate the financial obligations that Turkish companies will face as a result of European Green Deal. European Union, to which 50% of the Türkiye's products exports, approaching a protectionist line with the carbon border adjustment mechanism (CBAM) so initial steps should be taken quickly by Türkiye. According to 2020 data, Türkiye ranks 12th in the world in terms of renewable installed capacity. Türkiye is one of the leading countries in the global arena in terms of renewable resource diversity and potential with a total area of 1 million 245 thousand km2 including territorial waters, continental shelf and exclusive economic zone. Türkiye, with its large surface area, needs to create regional models before taking nation-wide decisions, especially on new & renewable energy technologies and emerging trends. In this sense, the only and the best way to use our limited sources efficiently would be to first create an ecosystem in relevant technologies through clusters in the most favorable regions with regional incentives, and then support the process by taking nation-wide decisions.

The development process of the South Marmara Hydrogen ecosystem, which officially started in 2018 with the expert reports and regional strategy documents published by GMKA, paved the way for two hydrogen projects that will be considered as the most concrete steps for the region and Türkiye. While focusing on increasing the installed capacity in the production of green hydrogen and its derivatives, the Agency has given an important place in its policies to the development of domestic capacity in the critical equipment of green hydrogen technologies and has decided to support initiatives in this direction in order not to obligate Türkiye to new foreign dependencies. Among those two hydrogen projects, the contract for the Guided Project titled "South Marmara Hydrogen Shore Platform" was signed on March 15, 2023 and the implementation period started. When it comes to EU-funded "South Marmara Hydrogen Shore - HYSouthMarmara" Valley Project, which has been developed in integration with the Guided Project, has a much wider scope with 8 work packages and its grant agreement was signed on June 30, 2023. HYSouthMarmara Valley Project, which has a total budget of 37.8 MEUR, set a record for Türkiye in the history of Horizon Europe Framework Programs with 8 MEUR grant support.

Keywords

renewable energy, hydrogen, green hydrogen

LUC JARRY
Air Liquide, France

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	15:50 - 16:10 (Istanbul time, CET+02:00)
Chair	SERKAN ŞAHİN

Hydrogen Combustion Technologies for a Smooth Transition

Abstract

Historically, the industry has favored natural gas as an energy source because it is an established technology, with low price, ease of control and the fact that there is no requirement for storage facilities. But today to reach carbon neutrality by 2050, carbon free hydrogen is one possible option to replace fossil fuels (notably NG or fuel oils) as feedstock, and significantly reduce GHG emissions. With Hydrogen combustion several other options might emerge, alone or combined, with the electrical melter, co-firing with Biogas, heat recovery and ultimately Carbon capture (CCS). All these energies can be combined with oxy-combustion technology for better effectiveness; that technology already generated the first improvement of thermal efficiency and productivity. A hydrogen-based solution will play a pivotal role in energy decarbonization. Air Liquide, within its commitment to reduce its carbon footprint has set up a program for testing and adapting their technologies, like its burners range, to the new H2 era, as an alternative to accomplish the overall decarbonization targets. The strategy proposed implies a smooth transition from typical hydrocarbon fuels to H2 with pure oxygen. Having hydrogen ready burners is one of the steps together with developing expertise and deploying technical proven and cost-effective technology solutions. The presentation will introduce how Air Liquide existing burners are being tested and adapted to be used with hydrogen as well as performances reached. H2 combustion technologies development, from production to the combustion chamber will be discussed too.

Keywords

hydrogen, combustion, technologies, energy transition

SJOERD STELWAGEN, Rui Carneiro, Oscar Verheijen, Luuk Thielen
Celsian Glass & Solar B.V., The Netherlands

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	16:10 - 16:30 (Istanbul time, CET+02:00)
Chair	SERKAN ŞAHİN

Regenerator Modelling for Energy Optimization

Abstract

One of the ways to reduce energy costs and CO2 emissions is to optimize the energy efficiency of the glass furnace by improving the heat recovery of regenerators. Improving the regenerator efficiency requires a detailed simulation of the heat transfer between the checker pack and hot flue gas on one hand and combustion air on the other hand.

In addition, the flow of flue gas and combustion air during the firing cycles also affects the efficiency of heat transfer. Finally, the overall regenerator performance also depends on the regenerator design and the cycling time. The presentation will show the results of a detailed regenerator simulation and its impact on the energy efficiency of a glass furnace.

Keywords

regenerator design, performance optimization, modeling techniques, flue gas, checker pack

ERNESTO CATTANEO
Stara Glass, Italy

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	16:30 - 16:50 (Istanbul time, CET+02:00)
Chair	SERKAN ŞAHİN

Contemporary Furnace and Process Design for a Sustainable Glass Production

Abstract

The glass industry is responsible for 5% of the total European industrial emission of CO2. This calls for solutions to be adopted immediately, in order to solve or at least mitigate such a crucial issue. What are the leverages in the hands of glass furnace designers to face this situation? The main ones are well known increase of efficiency and heat recovery, electrification (where power generation is renewable), alternative fuel combustion, and carbon capture. How do such solutions affect furnace design? What are the ongoing innovation projects fostering this change? The speech will deal with all the above, and more.

Keywords

furnace, design, innovation, efficiency, sustainability, carbon capture

GARY CAFÉ
Schneider Electric, Netherlands

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (I)
Date	NOVEMBER 2, 2023, Thursday
Time	16:50 - 17:10 (Istanbul time, CET+02:00)
Chair	SERKAN ŞAHİN

The Electrification of The Glass Industry: Learning from The Past and Present to Drive The FUTURE

Abstract

Obviously, electrical energy will play a major role in decarbonizing the glass manufacturing process even if hydrogen firing is considered. Already today we see new initiatives moving towards it, mainly focusing on using electric power directly into the glass melting process. However, the use of electrical power in glass melting has been around since electrical energy became industrialized, mostly in the form of Joules heating. There has been even a period in which large all-electric melters were operational, specifically after new electrode materials became available. The big ones vanished soon after due to low natural gas prices, but smaller ones are still successfully in operation. The use of green electrical energy is extremely attractive because of its high energy and carbon efficiency furnaces are relatively simple and easy to control but also have drawbacks. Now that many are looking into new, low-carbon glass melting methods we must reconsider the pros and cons of electric melting again – and how coupling this with digital technologies as well as decarbonization programs can help. Also, how this transition will be a journey so, it's important to work with partners across the phases of a) consulting/engineering, b) implementation, c) lifecycle services so that learning from each project feed directly back into a) making the next project(s) even more successful. So, let's have a look at the past, and the present, and specifically focus on the future and possible problems that we must overcome. Along with some features which might help us today and, in the future, to stay competitive on our quest towards carbon neutrality.

Keywords

electrification, decarbonization, decarbonization, digitization, digitization, digital twin, renewable energy, sustainability, electric melting, hydrogen

ANNE JANS FABER **(Invited Speaker)**
Glass Futures, United Kingdom

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II)
Date	NOVEMBER 3, 2023, Friday
Time	11:20 - 11:50 (Istanbul time, CET+02:00)
Chair	ÖZGÜR ACAR

Glass, Steel, Ceramics - Not as Different as We Appear

Abstract

The foundation industries comprise the metals, ceramics, glass, chemicals, paper and cement sectors, who combined produce 28m tonnes of material per year, and are worth £50bn annually to the UK economy. They are also the UK's biggest industrial polluters and responsible for approximately 50 million tonnes of CO_2 per year, or 10% of the total CO_2 emitted by UK homes and businesses. Global leaders in innovation, research, technology from across the UK foundation industries have come together to form the Foundation Industries Sustainability Consortium (FISC). Funded by Innovate UK as part of the Transforming Foundation Industries (TFI) Challenge, FISC brings together The Centre for Process Innovation (Chemicals), Glass Futures, Lucideon (ceramics), the Materials Processing Institute (metals) and the Henry Royce Institute (universities). By working together FISC can leverage the deep understanding and capabilities of its partners to help the companies operating in the foundation industries and the supply chains that use their materials to improve. FISC's first project is EconoMISER (Economic Materials Innovation for the Sustainable and Efficient Use of Resources) and will address the common challenges through collaborative projects based on the following themes;

- Alternative Fuels
- Circular Economy, feedstock, recycling and reuse
- Digital control and sensors
- Process optimisation
- Sustainable materials development In this presentation the specific topics which are most relevant to the glass industry and which are being addressed within EconoMISER will be highlighted.

Keywords

decarbonisation, circular economy, energy efficiency

GÜRHAN DURAL **(Invited Speaker)**
7Cbasalia Global, Türkiye

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II)
Date	NOVEMBER 3, 2023, Friday
Time	11:50 - 12:20 (Istanbul time, CET+02:00)
Chair	ÖZGÜR ACAR

Decarbonisation of Glass Industry by Basalia's Technology

Abstract

The impact of Green Deal and similar initiatives on the glass industry will be substantial, mainly due to the impossibility of reducing combustion energy beyond a certain point, unavailability of full-electric mass technologies and sufficient green electricity, infancy, and ineffectiveness of hydrogen energy, as well as low profit margins that cannot sustain high process costs. The only robust, economic, and green solution for the carbon crisis the glass industry is facing the revolutionary Basalia Bio-circular Technology, through which CO_2 and all other pollutants and greenhouse gasses in the chimney stack, namely NO_x, SO_x and hydrocarbons can be completely eliminated without creating additional waste. The Basalia invention by Mr. Ahmet Basal is based on restoring the element cycles of nature broken by linear economies using tools of nature itself. A culture of microorganisms trained to survive and thrive in all sorts of solid waste is used to ferment a random mixture of organic and inorganic waste, releasing hydrogen rich Basalia gas and the Basalia solid. Basalia solid can subsequently be used in aqueous and solid-state systems to convert all chimney gases into stable natural compounds. In this decarbonization process, no additional energy or chemicals are used.

Keywords

bio-circular technology, decarbonization, green solution, waste

STEVE WHETTINGSTEEL
Krysteline Technologies Ltd, United Kingdom

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II)
Date	NOVEMBER 3, 2023, Friday
Time	12:20 - 12:40 (Istanbul time, CET+02:00)
Chair	ÖZGÜR ACAR

Photovoltaic Cell Deconstruction and Recovery

Abstract

As the photovoltaic cell (PV) industry continues to evolve at a pace to help the world reach carbon neutrality the recycling of used damaged or low efficiency cells from the first round of large-scale installations are retired. Science and technology is driving the rapid evolution of a sustainable and commercially viable deconstruction system.
We explore the status of legislation and how recycling strategies and processes are evolving to meet diverse requirements. We review financial motivations and how legislation may become an integral part of the PV cell recycling landscape and how a traditional tonnes-based system may be better replaced with a more quantifiable alternative.
By supporting science and stimulating market uptake across various low CO_2 applications there is a demonstrable improvement in the commercial viability of PV Cell recycling, stimulating investment and encouraging legislation. Implementing a more encompassing strategy will create opportunities for recyclers to financially benefit from alternative low CO_2 products in its decarbonisation strategy. The interaction between science and industry is the cornerstone of revaluing and decarbonising deconstructed materials. Traditionally science is too slow and cumbersome to meet the terms of most investors, we consider how industry must interact with academia to create low CO_2 products from PV Cells for today and the future.

Learning Objectives:
- Consider how a more inclusive CO_2 based strategy could impact the PV recycling landscape
- A greater understanding of how location determines viability and outcome and how the complexities of market dynamics could establish a fairer more logical national and international approach to PV Cell deconstruction and resource recovery
- Understand the opportunities for recovered materials and how investing into PV recycling could offer significant returns.

Keywords

photovoltaic cell, decarbonisation, PV Cell recycling, recovered materials

NEIL SIMPSON
Simpson Combustion and Energy Ltd, United Kingdom

Session	ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES (II)
Date	NOVEMBER 3, 2023, Friday
Time	12:40 - 13:00 (Istanbul time, CET+02:00)
Chair	ÖZGÜR ACAR

In 2023 the Majority of End Fired Furnaces Run on 20 Minutes Reversals! Why not Optimise?

Abstract

In 1856 Siemens took out a British patent on the use of regenerators in furnaces to preheat air and gas. Coincidentally it was producer gas from coal with ~50% hydrogen. A visit to the World of Glass in St Helens offers opportunity to see remains of one of the World's first continuous regenerative tank glass making furnace built in 1887 by William Windle Pilkington. Glass was blown in large cylinders then cut, flattened and polished in to large sheets. "Every twenty minutes or so the gas and air were diverted to the opposite side." Whilst methods to form glass sheets have been developed in the intervening years and regenerators are typically for air only, in 2023 the majority of end fired furnaces still run on 20 minutes reversals and there is concern with small percentages of hydrogen. Looking to end-fired container furnaces with two to five IS machines it is not unusual to have a job change once per day. Whilst not ideal, due to job mix and delivery requirements there can be pull changes of 10-20% from maximum if not more. Assuming that the regenerators have been designed correctly for the maximum pull rate of the furnace. IF the furnace pull is at 80% of the design then there should be an opportunity to extend the firing period. If a site has two end-fired furnaces then typically one reverses on the hour and the other on the half hour with a reversal every 10 minutes. Clearly if the reversal time modulates there needs to be an inter-lock and/or priority to avoid both furnaces' gas stopping or starting at the same time. Assuming this provision is in place there is an opportunity to extend the firing period at reduced pull or to optimise and gain more glass. With 20minutes there are 72 reversals per day. If you extend to 21 then you reduce by 3 and at 22 by 6. The paper will look at a case study where utilizing existing commercially available technology it is possible to adjust the reversal firing time to optimise the reversal process.

Keywords

regenerators, energy reduction, decarbonization, furnace optimisation, emission reduction

Prof. Dr. JINCHENG DU **(Invited Speaker)**
University of North Texas, United States

Session	FUNDAMENTALS OF GLASS SCIENCE
Date	NOVEMBER 3, 2023, Friday
Time	14:00 - 14:30 (Istanbul time, CET+02:00)
Chair	ATİLLA ÇEBİ

Understand Glass Materials and Their Functional Applications Through Atomistic Computer Simulations

Abstract

Glass is one of the most complex materials, with glass structure and glass transition remaining the unresolved fundamental physical problems. Atomistic computer simulations, including both first principles and classical simulation methods, have greatly contributed to the understanding of glassy state, predicting glass properties, and designing of new glass compositions. These advances are due to repaid increase of computing power, active development and maturing of simulation methods such interatomic potentials and simulation algorithms. In this talk, I will provide an overview of these advances and present a few practical examples based on results of our group: from structure-property correlation in borosilicate glasses, glass-water interactions, to phase separation in oxyfluoride glasses based on molecular dynamics simulations. Recent advances in artificial intelligence and machine learning and their applications in glass research will also be discussed.

Keywords

glass structure, atomistic computer simulations, structure-property relationships, borosilicate glasses

Prof. Dr. DANIEL R. NEUVILLE **(Invited Speaker)**
IPGP – CNRS / Paris Institute of Earth Physics, France

Session	FUNDAMENTALS OF GLASS SCIENCE
Date	NOVEMBER 3, 2023, Friday
Time	14:30 - 15:00 (Istanbul time, CET+02:00)
Chair	ATİLLA ÇEBİ

How and Why Investigate the Structural Role of Elements in Glass and Liquid?

Abstract

Alkali and alkaline earth can be a network modifier or a charge compensator of AlO_4^- in aluminosilicate glasses and melts. As a function of its role, density, molar volume, viscosity, liquidus and glass transition temperature and more generally, macroscopic properties can change significantly. But how evaluate or prove this change of role? Recently, Helhen and Neuville (2014) have shown by comparing Raman in VV and VH polarization, that a new band appears in the VH Raman spectra when the role of Ca changes from charge compensator to network modifier. Furthermore, we have shown in the XANES spectra at the Ca K-edge, an important change in the Ca pre-edge peaks as a function of this same change of role (Cicconi et al., 2015).

Application to redox processes: in the case of an Fe_2+/Fe_3+ silicate, like window glass or natural lava, Fe_3+ can be consider playing same role than Al_3+ following result on viscosity (Dingwell, 1991). By looking Ca pre-edge peaks, in window glasses, is possible to follow a change in the role of Ca as a function of redox, similar at those observe with or without Al. This variation of the role of Ca is associated with the need of Fe_3+ to be compensated, and it proved that Fe_3+ acts in the network former as Al_3+. Furthermore, the large variations of the oxygen distribution around Ca could explain the large variations of the redox mechanisms in silicate melts.

Application to nucleation processes: Ca environment can be a key to understand nucleation process. Indeed, the nucleation process is very difficult to follow and needs highly sensitive tools. In fact, Ca is expected to move at lower temperatures than atoms involved in the glass network, in agreement with observation on relaxation processes (Gruener et al. 2001). As a consequence, Ca environment should be quickly modified in case of nucleation. Neuville et al. (2008) observed that, in a diopside composition, Ca pre-edge peak was modified and associated it with a change of Ca site from an "amorphous" one, to a "pre-nucleus" one. The quantitative approach of the Ca pre-edge XANES spectra, presented here, has the sensitivity required to further study nucleation.

To conclude, by looking the role of alkaline earth element in glass and melts, it is possible have a better knowledge of the structure of glass and melts, but also to better understand redox and nucleation processes.

Keywords

role of alkaline earths, spectroscopic methods, structure, redox, nucleation

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Session	FUNDAMENTALS OF GLASS SCIENCE
Date	NOVEMBER 3, 2023, Friday
Time	15:00 - 15:20 (Istanbul time, CET+02:00)
Chair	ATİLLA ÇEBİ

Natural Silicates in Fiberglass Production

Abstract

E-Glass fiber glass products have found a wide range of applications in composite markets, including automobile parts, printed circuit board, construction materials, wind turbine blades, pipes, etc. One of the commonly used major ingredients of E-Glass batch is kaolin, which provides sources of silica and alumina. This chapter focuses on the evaluation of alternative silicate minerals that may benefit the fiber glass production in terms of kinetics of batch-to-melt (BtM) conversion, stable and lower impurity iron, and lower BtM conversion energy. Using kaolin (free quartz less than 1%) as a control, four new natural minerals are investigated, high-silica kaolin (quartz greater than 50%), pyrophyllite, anorthosite, and wollastonite. In our study, a newly established FTIR protocol has been applied to track intermediate phase formation and final glass melt conversion. Literature reported XRD results and limited XRD analysis are used in supporting the IR characterization. According to our study, for E-Glass of CaO-Al_2O_3-SiO_2 based system, independent of the source of the natural silicate minerals used, BtM kinetics is primarily controlled by the availability of "free silica" to react with "free calcium oxide" derived from limestone in the batch at high-temperature above 1000°C.

Keywords

E-glass fiber, alternative silicate minerals, batch-to-melt kinetics, FTIR

GÜLİN DEMİROK
Şişecam R&D Center, Türkiye

Session	FUNDAMENTALS OF GLASS SCIENCE
Date	NOVEMBER 3, 2023, Friday
Time	15:20 - 15:40 (Istanbul time, CET+02:00)
Chair	ATİLLA ÇEBİ

Different Silica Sources and Their Effects on Melting and Foaming Behavior for E-Glass Production

Abstract

Kaolin is the major SiO_2 source in E-glass production. Depending on its properties, kaolin can be used in a batch with or without sand to achieve the target glass composition of E-glass.

This study covers experimental works examining the different types of kaolin used with or without sand and their effects on melting behaviors and foam formations. Foaming is the common problem in E-glass furnaces due to the low SO_3 solubility of E-glass. Optimum foam level is required for the fining process, but excess foam should be prevented in order to extend the furnace life and decrease the consumed energy.

In addition to effects of different raw materials, different C/SO_3 ratios by adding different amounts of anthracite and sodium sulfate were investigated in order to achieve both optimum foam level and good melting performance.
Experiments were done by using "High Temperature Melting Observation System (HTMOS)" which 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.

Investigations demonstrate that different types of kaolin induce dissimilar melting behaviors and generate different foam levels. Different SO_3 amounts and C/SO_3 ratios in the batches have a strong effect on foam formations. Raw material analyses, detailed SO_2 gaseous - temperature graphs of each batch and foam levels will be discussed in the presentation.

Keywords

e-glass, kaolin, foaming, melting

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Session	FUNDAMENTALS OF GLASS SCIENCE
Date	NOVEMBER 3, 2023, Friday
Time	15:40 - 16:00 (Istanbul time, CET+02:00)
Chair	ATİLLA ÇEBİ

Improvement of the Selenium Retention and Control of the Color Stability in Selenium Containing Glasses

Abstract

Selenium may exist in various oxidation states, including Se_2-, Se_0, Se_4+, and Se_6+ within the glass structure and depending on these different oxidation states, the color of the glass article changes. Selenium has been used in the glass industry for decades as a colouring agent, particularly for grey, bronze and pink glass products. Another known role of selenium in glass is its usage as a decolorizing agent in clear glass batches. Previous studies in the literature and industry experience obtained from the industry have shown that almost 30-90% of selenium either evaporates during melting process or remains in colourless form. Selenium retention can be influenced by several parameters such as selenium source, the amount of oxidizing and reducing agents taking part in the glass batch, furnace atmosphere, melting temperature, pull rate which indicates the residence time.

Selenium volatilization (low retention in glass) can cause an increase in the batch cost, color instability and environmental problems, therefore the present study aims to investigate the parameters that affect the selenium retention in the glass. In addition to the issue of selenium retention, it is aimed to study and comprehend the effect of the parameters on the oxidation level of selenium and, consequently, on colour stability. Glass batches have been prepared on the basis of the parameters to be investigated, with the addition of auxiliary raw materials such as sodium nitrate ($NaNO_3$) and manganese oxide (MnO_2). Chemical compositions and color parameters of the obtained glass samples were analyzed by using X-Ray fluorescence spectrometer and UV/Vis spectrophotometer. The effects of %Fe_2O_3, $NaNO_3$, MnO_2 used in the glass batch, the melting temperature on selenium retention and glass color were examined individually and these correlations were comparatively evaluated.

Keywords

selenium retention, color stability, $NaNO_3$, MnO_2, melting temperature

Dr. MARIAN KLISCH **(Invited Speaker)**
Forglass Sp. z o.o., Poland

Session	GLASS MELTING AND FORMING PROCESSES
Date	NOVEMBER 2, 2023, Thursday
Time	13:00 - 13:30 (Istanbul time, CET+02:00)
Chair	TOLGA UYSAL

Mixing Electrode (Electrode & Bubbler All in One)

Abstract

The Forglass mixing electrode (ME) is a tool that turns a glass furnace into a chemical reactor, in which the operator can influence the course of reactions and phenomena that make up the melting process and thus significantly accelerate it. ME systems enable the adaptation of increased shares of electrical power in fossil operated furnaces up to 50% without changing the rules of their operation, but with a significant improvement in their efficiency. The wide range of available operating parameters of ME systems (distribution of power and gas flow rates) provide previously unknown possibilities of quick and precise impact on the melting process. This is primarily expected during pull change, composition of glass or batch change, or troubleshooting. The synergistic interaction of vertically directed convection currents forced by ME systems with natural currents generated by density gradients significantly accelerates the processes of batch-to-glass conversion, sand dissolution and gas bubble removal, resulting in a product with higher chemical and thermal homogeneity at each of these stages. ME is not simply the sum of the functionality and advantages and disadvantages of standard electrodes and bubblers operating separately. The delivery of hot glass activated by ME systems accelerates the slowest reactions controlled by diffusion. The convective energy dissipation from vicinity of electrodes prevents refractory materials from overheating and directs the energy to the regions where it is needed, which is important in hybrid furnace. Placing gas release points at a height of 500 – 700 mm above the bottom also definitively removes the risk of erosive impact on the bottom often observed in the case of bubblers mounted in the bottom.

Keywords

mixing electrode; melting process; glass furnace

BURÇİN GÜL ARSLANOĞLU
Şişecam R&D Center, Türkiye

Session	GLASS MELTING AND FORMING PROCESSES
Date	NOVEMBER 2, 2023, Thursday
Time	13:30 - 13:50 (Istanbul time, CET+02:00)
Chair	TOLGA UYSAL

Pushing the Limits of Production in Float Furnaces

Abstract

Over the years, advancements in float glass furnace technology have been driven by various factors, including the improvement of glass quality, the enhancement of energy efficiency, and the response to environmental concerns. Today, the growing demand in key sectors such as automotive and construction, alongside increased investments in solar energy, is exerting significant pressure on the capacity limits of float glass furnaces. Undoubtedly, designing and commissioning a high-capacity flat glass furnace requires precise operational tuning to address the increasing need for premium products like mirrors, automotive glasses, and low-E glass competitive edge in the global marketplace.

In alignment with this vision, Şişecam has invested in a new float line in Turkey, which will boast a nominal capacity of 1200 tons per day for clear glass production. Based on the modelling studies carried out by in-house developed Şişecam Furnace Model code, together with extensive production and structural design expertise, a float furnace with a capacity of 1200tpd clear glass has been designed by Melting Technologies and Engineering of Şişecam R&D. The scope of the modelling study was expanded to investigate potential opportunities for design and operational improvements in the current design allowing for enhancing both the design and operational aspects, enabling adaptability to future scenarios with increased furnace capacity demands or elevated standards for glass quality.

In this context, the primary focus of this modeling study is to tackle the challenge of enhancing the melting capacity in float furnaces without substantially expanding the melting area. Specifically, it focuses on investigating the relationship between glass depth and waist cooler submersion and their impact on effectively managing convection currents and temperature profiles in large capacity float furnaces. The findings of this modelling study offer valuable guidance for potential improvements to further enhance the melting capacity in float furnaces.

Keywords

high-capacity float glass furnace; mathematical modelling; capacity limits; design improvements

MARTIN KILO[1], Andreas Diegeler[1], Rick Niebergall[1], Tina Waurischk[2], Stefan Reinsch[2]
[1] *Fraunhofer ISC, Germany* [2] *BAM Berlin, Germany*

Session	GLASS MELTING AND FORMING PROCESSES
Date	NOVEMBER 2, 2023, Thursday
Time	13:50 - 14:10 (Istanbul time, CET+02:00)
Chair	TOLGA UYSAL

GlassDigital - Digitalization of Glass-Development

Abstract

Glass development works traditionally iteratively by melting series of samples, investigating their properties, and then melting more samples with modified composition. The whole process might be pretty long and can take several months, up to one year in special cases. Fraunhofer ISC has developed a rapid-screening system during the last years, which is currently being optimized in collaboration with the BAM in Berlin. Within the project GlassDigital, this experimental device is coupled with a toolbox for digitalized glass development, which includes a data base for glass property selection from literature, modeling the glass properties, and developing an ontology for the laboratory glass melting process. Furthermore, the robotic glass melting systems currently running at the BAM in Berlin, which allows the melting of 20 samples for 24 hours is further development, including a new viscosity measurement system and the optical detection of foaming.

Keywords

glass development; digitalization; glass screening

DIRK SCHNURPFEIL
Nikolaus Sorg GmbH & Co. KG, Germany

Session	GLASS MELTING AND FORMING PROCESSES
Date	NOVEMBER 2, 2023, Thursday
Time	14:10 - 14:30 (Istanbul time, CET+02:00)
Chair	TOLGA UYSAL

Sorg's "CLEAN-Melter": Advanced Technology for a Sustainable Future

Abstract

Company Sorg is the leading manufacturer of highly efficient glass melting furnaces in the field of air/gas and oxygen/gas combust potential as in the field of all-electric melting, allowing its customers to achieve significant cost saving potentials in ownership costs while producing reliably high-quality glass.

Boosted end fired furnaces in combination with cullet or even batch pre-heating are the most efficient furnaces today. A short review will be given about the latest best available techniques like the batch pre-heater-system "BATCH3®".

All-electric furnaces offer already today the possibility to reduce carbon emissions from firing down to Zero. Since more than 50 years company Sorg is supplying all-electric glass-melting furnaces like the VSM® successfully to its customers. The latest design developments are meant to eliminate pull rate limitations from the past.

Combining the best out of the known technologies, firing, heat-recovery and all-electric, a new hybrid furnace with extraordinary high shares of electric heating up to 80% was developed, Sorg's new "CLEAN-Melter®".

After a general introduction to this new Hybrid-technology and a review of the history developing the design, the presentation will give some insights about which questions have been raised during the development period and how company Sorg found the right answers to them.

Keywords

glass melting furnace; hybrid furnace; furnace design

PELİN AKKAYA
Şişecam R&D Center, Türkiye

Session	GLASS MELTING AND FORMING PROCESSES
Date	NOVEMBER 2, 2023, Thursday
Time	14:30 - 14:50 (Istanbul time, CET+02:00)
Chair	TOLGA UYSAL

Melting Behavior of Natural Inclusions in Raw Materials

Abstract

Silica sand is an essential raw material for glass production. The specifications of silica sand for each type of glass are crucial, such as chemical purity, grain size, grain shape and their impurities (inclusions). Some of the impurities in the sand can be eliminated by processing yet some of them cannot be avoided. This paper elaborates that as an impurity in the sand, chromite minerals' dissolution in glass, which can cause glass defects depending on the particle size. The change in 0.200 mm and 0.250 mm grain size chromite minerals were investigated at 1350^{0}C, 1400^{0}C and 1450^{0}C, respectively. It was observed that the rate of size change in the grain diameter increased with increasing temperature. Due to chemical composition of chromite mineral, aluminum and magnesium start to dissolve first in soda lime silicate glass, and then chromium content transforms into chromium oxide. Besides, it was realized that transformation rate depends on the temperature, as well.

In this study, the dissolution rates of chromite minerals in different shapes and sizes at different temperatures were observed and the critical particle size of the chromite mineral for glass production was determined.

Keywords

chromite, raw material impurities, dissolution, glass production, ophiolite

THOMAS PREUßNER **(Invited Speaker)**
Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP, Germany

Session	GLASS SURFACES, INTERFACES AND COATINGS
Date	NOVEMBER 2, 2023, Thursday
Time	13:00 - 13:30 (Istanbul time, CET+02:00)
Chair	OZAN ÖZER

From Lab to Pilot – Opportunities and Challenges of Large-area Inline Flash Lamp Annealing

Abstract

The performance of thin film coating materials strongly depends on their stoichiometry, defect density, morphology, and others. Annealing procedures or deposition at elevated temperatures are commonly used to adjust and alter these for given applications.

However, the applicable temperatures are often limited by substrate materials and/or economic considerations. Therefore, rapid thermal annealing processes are an alternative technology enabling thermal treatment of functional layers and coatings. The limited penetration depth of the imposed heat can even allow thermal treatment on temperature sensitive substrates. By superimposing periodic flashes and moving the substrate perpendicular to the lamp axis, large areas can be continuously and homogeneously annealed. Recent developments transferred this technology from lab-scale to a pilot-scale level and even beyond providing a reproducible and effective large area treatment. In comparison to conventional furnace processing, superior high energy efficiency is demonstrated at a comparatively small machine footprint and high throughput.

The corresponding Flash Lamp equipment with a lamp length of 750 mm has been implemented in an inline vertical coating machine platform at Fraunhofer FEP providing sampling and development capabilities up to pilot scale. In this configuration the impact of FLA on thin film materials synthesized by PVD and PECVD coating technologies can be sampled without vacuum breaking.

This talk introduces the principles of FLA as well as the setup at Fraunhofer FEP and relating them to the conclusions of selected applications addressed over the last couple of years. Examples are, large area TCO coatings in combination with inline FLA on rigid and ultra-thin bendable glass, treatment of Ag-based low-E multilayer stacks, formation of antimicrobial nanoparticles and even the toughening of plain glass substrates. Furthermore, the FLA process itself is the focus of research and commercial validation. Therefore, topics like long-term stability, scalability and energy efficiency will be discussed.

Co-Authors

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Keywords

annealing, large area, thin film, FLA, ultra-fast, short-term

Dr. CALVIN CHENG **(Invited Speaker)**
Edgehog Advanced Technologies Inc., Canada

Session	GLASS SURFACES, INTERFACES AND COATINGS
Date	NOVEMBER 2, 2023, Thursday
Time	13:30 - 14:00 (Istanbul time, CET+02:00)
Chair	OZAN ÖZER

Enhancing Solar Panel Efficiency through Wide-Angle Anti-Reflection Technologies

Abstract

Maximizing solar panel performance requires optimal installation angles, yet challenges arise when sunlight hits the panels at angles greater than 55 degrees for around 30% of the time, leading to significant reflections. This work explores the application of nanotextured anti-reflection technologies to mitigate losses especially at wide angles. We present a new generation of moth-eye nanotexturing that creates a gentle gradient in the index of refraction for transmitted light, no matter the wavelength and angle of incidence. Across diverse geographic and climate conditions, this novel approach to anti-reflection can enhance annual solar panel power output by 5-6% for optimally tilted panels and up to 12% for building-side mounted vertical panels such as those used in urban integration. Our work demonstrates how wide-angle anti-reflection technology can advance solar energy efficiencies on a global scale.

Keywords

anti-reflection, solar, moth-eye, nanotexturing

GÖKSENİN KURT ÇÖMLEKÇİ, Gülşah Kahraman, Ezgi Sözen, Emir Çetinalp

Şişecam R&D Center, TurkeyTechnology FEP, Germany

Session	GLASS SURFACES, INTERFACES AND COATINGS
Date	NOVEMBER 2, 2023, Thursday
Time	14:00 - 14:20 (Istanbul time, CET+02:00)
Chair	OZAN ÖZER

Graphene Oxide Doped Sizing Effect on Glass Fiber Reinforced PA Mechanical Properties

Abstract

Today, it is well known that high-performance high-tech products using composites containing various nano materials. Graphene is a new generation two-dimensional material offering unique properties and has gained significant prominence among other nanomaterials. By incorporating a small amount of graphene into polymer matrices, composites with enhanced properties such as hardness, tensile strength, friction, and wear resistance can be achieved.

Due to the lack of surface functional groups on graphene, challenges arise in its application, as it struggles to disperse in the composite and in water. Therefore, in this study, we examined graphene oxide obtained from a domestic supplier. We explored its use in the glass fiber product utilized in epoxy and in polyamide (PA) applications, which have high mechanical requirements, particularly in thermoplastics, especially in the automotive industry.

The glass fiber, compatible with PA, was produced by incorporating the graphene oxide into the sizing during glass fiber production to improve the fiber/matrix interface properties and/or improve the dispersion of nanofiller within the matrix. Then the composite parts were prepared by using extrusion and injection method. The results show that the izod impact values were increased as 11% by dopping the glass fiber surface with graphene oxide.

Keywords

graphene oxide, glass fiber, sizing, nano-material

SEZEN ÖYKÜ KINACI, Damla Koçak, Selçuk Yerci
Middle East Technical University, Türkiye

Session	GLASS SURFACES, INTERFACES AND COATINGS
Date	NOVEMBER 2, 2023, Thursday
Time	14:20 - 14:40 (Istanbul time, CET+02:00)
Chair	OZAN ÖZER

TiO_2/SiO_2 Aerogel Coating on Glass Provides Anti-Reflection, Water Harvesting, Anti-Bacterial and Self-Cleaning Properties

Abstract

Namib desert beetles can collect water from the air due to their hydrophobic/hydrophilic patterns on their surfaces. Hydrophilic region on the surface attracts water as the hydrophobic region repels, contributing to the sliding motion of the collected water. Inspired by this surface, a TiO_2/SiO_2 aerogel coating with anti-reflective and water-harvesting properties is proposed in this study. The aerogel is synthesized, and spray coated on glass using titanium diisopropoxide bis(acetylacetonate), methyltrimethoxysilane (MTMS), and tetraethoxysilane (TEOS) as precursors and methanol as solvent. TiO_2 in the aerogel is expected to degrade organic pollutants under UV irradiation resulting in an antibacterial effect. The photocatalytic property of TiO_2 provides a hydrophobic surface of the coating to transform into super hydrophilic when irradiated with UV light. A UV photomask is used to make hydrophilic/hydrophobic patterns, mimicking the Namib desert beetle surface. Super hydrophilic regions remain even after two weeks in the absence of light, showing long-term stability. After two months, super hydrophilicity transforms into hydrophilicity, still showing water-attractive characteristics after long-term storage in the dark. Additionally, the coating exhibits anti-reflective characteristics due to aerogels' inherent porosity, resulting in a lower refractive index than glass. Quarter-wave thickness is achieved through ultrasonic spray coating, contributing to anti-reflective properties. The proposed anti-reflective and water-harvesting coating has potential in various photovoltaic (PV) applications such as agricultural PV (i.e., Agri-PV), building-integrated PV (i.e., BIPV) and vehicle-integrated PV (VIPV), where anti-reflection and self-cleaning properties provide more power output as well as water-harvesting property can be used, for example, to irrigate the plants underneath and as windshield washer fluid.

Keywords

anti-reflective coating, water-harvesting, photo-induced hydrophilicity, anti-bacterial, self-cleaning, photocatalysis, thin film

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Session	GLASS SURFACES, INTERFACES AND COATINGS
Date	NOVEMBER 2, 2023, Thursday
Time	14:40 - 15:00 (Istanbul time, CET+02:00)
Chair	OZAN ÖZER

Development of Water Based Silver Mirror with Improved Durability

Abstract

While environmental problems and their global effects risk the sustainability of the environment, they also cause serious threats to people's safety, health, productivity, diversity of living species, food, and water resources. Fighting against environmental problems and their outcomes has become important on a global scale. Concerns about environmental pollution encourage industrialists and scientists to search for and benefit from more environmentally friendly solutions. As the global concern for environmental sustainability continues to rise, water-based mirror coatings have come to the forefront as a noteworthy solution, coupled with their totally VOC and heavy metal free nature.

Here, we devised an ecologically friendly silver water-based mirror using a novel and domestic paint system developed in the flat glass mirror product category, which has the highest paint usage. This paint system is unique in that it is environmentally friendly, completely water-based, free of volatile organic compounds (VOC) and toxic heavy metals such as lead or chrome (VI). With the developed product, a strategic contribution is achieved to the mirror activities of Şişecam flat glass product group focusing on sustainable environment. The major goal is to successfully integrate the newly developed coating system into the production line and to obtain enhanced performance in mirrors that undergo rigorous industry standards. To achieve these objectives, it has been concentrated on the development, application, and improvement of water-based mirror coatings. In this study, the performance of the mirrors has been evaluated by using both physical criteria for silver coated mirror glass and chemical requirements for surface coating systems. The features of the paint system, the most significant durability trials performed on water-based mirrors, and optimum application procedures for future attempts are presented in the current study. Our findings not only compare capabilities, but also suggest design objectives for the next generation of water-based mirrors for architectural applications.

Keywords

water based glass mirror, low solvent mirror, solvent free silvered glass mirror

Dr. DAVID KUSUMA **(Invited Speaker)**
World Design Organization, USA

Session	PRODUCT DESIGN (I)
Date	NOVEMBER 3, 2023, Friday
Time	11:20 - 11:50 (Istanbul time, CET+02:00)
Chair	ALPER EMNİYETLİ

A New Emphasis on Research & Innovation to Drive Game-Changing Product Solutions

Abstract

Today's highly competitive market has made it necessary for global companies to reinvent themselves to focus on premium and value-added products. To increase their capability for competitiveness and avoid being stuck in the past, this focus requires a new emphasis on design research & innovation, using a combined design and technology vision to drive a continuous process of discovery, coupled by a willingness to take larger risks for potentially higher long-term rewards.

However, this effort cannot be successful without a full understanding of the company's history and culture and building upon the foundation of long-established core competencies. This talk will describe a methodology developed at Tupperware to maximize creativity and invention by defining future products based on design values, emerging technologies, innovative materials, and market trends. The process employs an "open innovation" model to build partnerships with external scientists, universities, and technology institutions to push the potential of product solutions to a higher level so that new functional benefits can be achieved, which are non-obvious, and which do not currently exist.

Designers have more availability and access to new resources, information, and technologies than ever before. But each new opportunity poses both challenges as well as benefits. What are the key considerations for new products which will bring the greatest benefit for the consumer, but still provide long lasting use, and protect both public health and the environment? This strategic approach will show how collaboration is the new competitive advantage. Highlighted will be product case studies to show how to maximize human benefit while still achieving alignment with the UN Sustainability Goals.

Keywords

competitiveness, innovation, collaboration, sustainability

SERTAÇ ERSAYIN **(Invited Speaker)**
World Design Organization
Industrial Designers Society of Türkiye, Türkiye

Session	PRODUCT DESIGN (I)
Date	NOVEMBER 3, 2023, Friday
Time	11:50 - 12:20 (Istanbul time, CET+02:00)
Chair	ALPER EMNİYETLİ

Sustainable Collaboration is The First Step of Creative Innovation and Design

Abstract

From start-ups to high-tech companies from social initiatives to global communities; collaboration allows different sectors, such as NGOs, government, businesses and communities come together and pool their resources, knowledge and expertise. Collaborative efforts can enable systemic change and address sustainability challenges by leveraging the challenges of each sector. It promotes knowledge sharing and innovation, as well as the sharing of collaboration, knowledge, best practices and innovative ideas. By working together, stakeholders can learn from each other's experiences. Collaborative efforts have the potential to create a greater impact than individual actions. By combining diverse perspectives, skills, and resources, collaborations can address sustainability issues on a larger scale and create threatening change. Sharing risks, including funding and technology, enables stakeholders to improve their capacity to address sustainability situations more effectively. While the inclusive process differentiates stakeholders, it can contribute to their perspectives, needs, aspirations, and guarantee the future of sustainability. Sustainability challenges are complex and require long-term solutions. Collaborations provide a platform for sustainable efforts by fostering relationships and partnerships that go beyond the short-term project. This platform helps to build long-term cooperation, resilience in the face of changing conditions and ensures continuous progress towards a sustainable future. Sustainable collaboration is the first step of creative innovation for building up the future.

Keywords

collaboration, innovation, sustainability, partnership

DEĞER DEMİRCAN ACILIOĞLU
Şişecam Design Center, Türkiye

Session	PRODUCT DESIGN (I)
Date	NOVEMBER 3, 2023, Friday
Time	12:20 - 12:40 (Istanbul time, CET+02:00)
Chair	ALPER EMNİYETLİ

Design Strategies in Glassware

Abstract

Product design needs a holistic view from users to market. Each business field has its own dynamics to consider, this is relevant from household appliances design to glassware and packaging design, almost in all scales of industrial design services.

Story of a design perspective walking through a historical view from different scales of design projects applied using consumer centric designs and with several check points, to find out best solutions for the common benefit of related company and users.

Focusing on sustainable design solutions is the contemporary common ground for all design disciplines today. Cases and studies about sustainable products in glassware and packaging design will be discussed accordingly.

Keywords

sustainability, glassware & packaging, consumer centric design

PELİN KARABAY, Oğuzhan Öz
Şişecam Design Center, Türkiye

Session	PRODUCT DESIGN (I)
Date	NOVEMBER 3, 2023, Friday
Time	12:40 - 13:00 (Istanbul time, CET+02:00)
Chair	ALPER EMNİYETLİ

Fundamentals of Ultra-Lightening in Glass Packaging

Abstract

The increasing concerns about environment's well-being, global challenges, and conscious recycling have led to a growing demand for sustainable practices and solutions. Noting that social behaviors will change rapidly depending on the global warming problem triggered by climate change, experts emphasize the necessity of reducing carbon emission rates worldwide for a sustainable environment. Within the framework of this policy, almost all developed countries have mobilized, and Turkiye has made official its efforts to prevent global warming with the Paris agreement that it has just signed. In this context, taking effective measures, both on a national basis and as Şişecam, constitutes the most important heading of our innovation and design strategy. In this context, many activities and projects with a design content were carried out by Şişecam Design Center, Glass Packaging department, in order to design sustainable products, reduce raw materials, increase production efficiency and save energy.

In particular, ultra-light projects to be made in different volumes of pressurized/non-pressurized products were evaluated, and designs with low-emission carbon footprints that provide logistics and stowage advantages are planned. These design processes can be evaluated as current product research (glass packaging all over the world to compare weight, volume, dimensions, creating simulation references with existing productions, mold design, production testing and reporting on the selected design after design studies and simulation studies. The packaging has the product in it). It is also among the targeted outputs to ensure that the product is kept in good condition and that its strength is at least as successful as the existing products with appropriate coating systems.

In this context, at the beginning of the epidemic, in 2020-2021, a 110g mineral water project from the non-alcoholic product sector was designed and production trials and customer filling tests were successful, and communication announcements were made. In May 2022, industrial trial production of 110g was also started.

This research aims to share the key points of ultra-light projects within the scope of new product design and simulation-driven product development through achieved projects.

Keywords

sustainable, ultra-light, design, analysis, coating

RIANNE KOENS **(Invited Speaker)**
Otura Design, Netherlands

Session	PRODUCT DESIGN (II)
Date	NOVEMBER 3, 2023, Friday
Time	14:00 - 14:30 (Istanbul time, CET+02:00)
Chair	YEŞİM GÜLENÇ

Circular Design

Abstract

As a designer, Koens believes that she is responsible for what she brings to the world. Her designs usually depend on existing production facilities. These are often not yet ready for the circular economy. She therefore, has made it her artistic ambition to break through entrenched production systems in order to achieve positive circular results. Otura Design offers Circular training using the Circo-strategy to identify value losses and to analyze opportunities. Long-term projects can be found in Zero Burn and Rethink Softly. Koens believes that the creative talent of her and her colleagues is needed now more than ever before to come up with new innovative insights for the circular economy. She believes the role of designers today has expanded from just 'form creators' to initiators and insight providers.

Keywords

circular design, circular economy, circo-strategy

MELİKE ALTINIŞIK **(Invited Speaker)**
Melike Altınışık Architects - MAA, Türkiye

Session	PRODUCT DESIGN (II)
Date	NOVEMBER 3, 2023, Friday
Time	14:30 - 15:00 (Istanbul time, CET+02:00)
Chair	YEŞİM GÜLENÇ

Fusion of Maestros

Abstract

Melike Altınışık's presentation delves into the captivating synergy that unfolds when nature, architecture, and technology converge, emphasizing the collaborative efforts across disciplines to drive innovation. Through a showcase of distinctive achievements from MAA's diverse work, such as the futuristic 365-meter Çamlıca Tower in Istanbul, the unique TPAO Headquarters in Zonguldak, the eco-friendly Coa Hills in Sapanca, and the groundbreaking Robot and AI Museum in Seoul, Altınışık underscores how the fusion of natural inspiration and technological expertise results in spaces that seamlessly meld with their environment.

This enlightening talk spotlights the intricate processes of collaboration that underpin these remarkable projects, spotlighting how the shared expertise of different disciplines yields transformative architectural solutions. By delving into these compelling case studies, Altınışık eloquently demonstrates how collaborative innovation can harmonize diverse influences, ushering in new design paradigms that reshape our built world.

At its core, Melike Altınışık's discourse uncovers a rich tapestry of connections that extend beyond structures, shaping not only the physical spaces we inhabit but also our perception of the world. It offers a compelling viewpoint on the power of interdisciplinary collaboration between nature, architecture, and technology, illustrating how their symbiotic partnership births visionary designs that inspire awe, kindle creativity, and leave an enduring legacy of harmonious coexistence.

Keywords

Innovative, transformative architecture, urbanism, collaboration,

FATİH BAHADIROĞLU
Şişecam Marketing, Turkey

Session	PRODUCT DESIGN (II)
Date	NOVEMBER 3, 2023, Friday
Time	15:00 - 15:20 (Istanbul time, CET+02:00)
Chair	YEŞİM GÜLENÇ

Sustainable Glazing Solutions

Abstract

Sustainable gazing solutions in architecture are essential for creating livable and environmentally friendly spaces. The Glass House, designed by Philip Johnson, exemplifies the potential of glass in architecture. With advancements in glass technology, buildings can now be both visually stunning and energy efficient.

One of the key benefits of using glass as a building material is its recyclability. Unlike many other materials, glass can be recycled and repurposed, reducing its environmental impact. This makes it an ideal choice for those who prioritize sustainability and want to minimize their carbon footprint.

In addition to its recyclability, sustainable glazing solutions have the ability to transform the way we experience buildings. By incorporating energy-efficient glazing solutions, architects can maximize natural light, reducing the need for artificial lighting during the day. This not only saves energy but also enhances the well-being and productivity of occupants.

By embracing sustainable glazing solutions, architects and designers can turn ordinary structures into extraordinary, eco-friendly spaces. These solutions not only enhance the aesthetic appeal of buildings but also contribute to a more sustainable future. With continued advancements in glass technology, the possibilities for sustainable architecture are endless.

In conclusion, the use of sustainable glazing solutions in architecture is crucial for creating livable and environmentally conscious spaces. The Glass House serves as a prime example of how sustainable glazing can be integrated into architectural design. By incorporating sustainable glazing solutions, buildings can reduce their energy consumption and carbon footprint. This not only benefits the environment but also creates healthier and more comfortable living and working environments for occupants. The Glass House demonstrates the potential of sustainable glazing to transform the way we design and experience buildings.

Keywords

sustainability, glazing solutions, technology, the glass house

YULII ALEKSEENKO, Natalia Balobanova
Şişecam Moscow, Russia

Session	PRODUCT DESIGN (II)
Date	NOVEMBER 3, 2023, Friday
Time	15:20 - 15:40 (Istanbul time, CET+02:00)
Chair	YEŞİM GÜLENÇ

Development of the Methodology for Calculation and Analysis of Blank and Blow Mold Cooling System in Ansys Software Environment

Abstract

To stay ahead of competitors, glass manufacturers are constantly striving to reduce the weight of their packaging while improving the strength, production speeds, and appearance of their products. The quality of mold cooling is a critical factor in the production process, as it plays a significant role in glass distribution.

In this project, we developed a methodology for analyzing mold cooling design and optimizing temperature distribution on the inner mold surface to increase cooling efficiency of blank and blow molds. Our methodology includes a variety of tools for visually comparing different cooling hole designs.

We used Ansys software to analyze the cooling effect of two different mold designs. Our results showed that the new designs had a significant positive impact on vertical temperature distribution and body ovality of the bottle. We were also able to control the cooling process by increasing and decreasing the flow rate in the required places by adding pins at the desired height.

Keywords

mold cooling, glass distribution, digital technologies, ansys

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[2]Şişecam Design Center, Türkiye

Session	PRODUCT DESIGN (II)
Date	NOVEMBER 3, 2023, Friday
Time	15:40 - 16:00 (Istanbul time, CET+02:00)
Chair	YEŞİM GÜLENÇ

Collaborate to Innovate: Sustainable Personal Care Product Packaging and System Solutions

Abstract

The increasing concerns about user well-being, global challenges, and conscious consumption have led to a growing demand for sustainable practices and solutions. Rapid consumer goods waste, especially packaging, demands sustainable, natural materials for products and packaging. This evolving consumer demand also requires products to exhibit enhanced functional performance. To achieve this, two fundamental approaches are proposed: empathetically designing by identifying problems and needs and creating solutions that consider the bigger picture, encompassing the planet and future generations. While recycling is valuable, it alone cannot resolve the environmental challenges since it demands substantial energy consumption. Reusing items, on the other hand, conserves energy resources. Existing systems could be reimagined as a continuous loop, where everything is cleaned, refilled, and reused, rather than functioning as waste or recycling bins. By implementing appropriate product-service systems, environmental harm can be minimized, and both consumers and producers can be encouraged to engage in this circular process. Brands seek refillable and reusable concepts for environmental compliance, brand loyalty, and deposit and reward schemes in intelligent packaging designs. Many international companies have already developed innovative business models centered around reusable packaging, creating a collaborative space for others to work towards influencing consumer behavior positively. This research aims to present proposals for personal care product packaging and systems that embrace sustainability principles, offering opportunities for secondary usage through refilling and reuse. In this study, research results on the usage experience of refillable glass packaging will be shared, conducted through a graduation project in collaboration between Eskişehir Technical University and Şişecam within the scope of university-industry cooperation.

Keywords

sustainable packaging, reusability, personal care products, circular economy, conscious consumption

ŞİŞECAM

38th INTERNATIONAL GLASS CONFERENCE

POSTER PRESENTATIONS

ALTAY ÇAPANOĞLU
Iris Inspection Machines, France

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Artificial Intelligence and Productivity

Abstract

Through years everyone, in industries, have heard about AI from any technological supplier or IT companies, or in the press. It is actually less frequent to observe concretely what it means, or look like, inside a factory. IRIS Inspection Machines always integrates its ideas into client's reality. Controlling cost efficiency, productivity and keeping a high glass quality is the key of an healthy factory. Our inspection lines are today already able to make a classification of the rejected defects to help the management in minimizing losses. In 2023, IRIS Inspection Machines, had started to raise the experience of AI in the market. Thanks to the AI we are able to optimize the inspection; for instance making automatically the difference between, surface blister, hard blisters and stone. This capability, without human's eyes interpretation, allows to boost the productivity. Quality management will be able to keep acceptable product and reject critical one, with the lower "false rejection rate". An other part of this development is to give a solution of our client's problem with turnover. Within the years, losing experimented staff, means losing competences, retirement or turnover. As a consequence it is arduous to maintain the same level of competences between all the personnel. The inspection lines need to absorb this challenge by keep and developing their own experiences; as a result our technology free factories from this burden, with providing the same inspection performances for all shift and line. Our R&D team, consisting of 12 people, had focused its effort on the development of our Artificial Intelligence software. In IRIS we had collected billions of defect types from our client's factories and developed mass learning soft and systems. This approach allows us today to precisely get the defects type with the AI software, while using the same language of our customer. Providing futurist idea is always pleasant, bringing it into reality is even better.

Keywords

glass inspection, AI, defect classification, productivity, quality

Ali Bagheri Behboud[1], Md Kawsar Ahmed[1], **ARDA KURUCU[1],** Göksenin Kurt Çömlekçi[2], Mustafa Ordu[1]
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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

High Strength and Alkali Resistant Zirconia Nanoparticle-Coated E-Glass Fibers

Abstract

Glass fibers are often used as reinforcing material in fiber-based composites owing to their excellent mechanical properties, low weight, and low cost. Glass fibers are essential components in a variety of applications, including wind turbines, airplanes, and aircraft. Improving glass fiber mechanical performance is crucial for the utilization of fiber-based composites in challenging circumstances. Furthermore, obtaining alkali-resistant glass fibers can broaden these materials' use in alkaline environment. Under alkaline conditions, hydroxyl ions attack the glass fiber's Si-O-Si structural network, causing the breakdown of glass unity. To achieve alkali-resistant glass fibers (AR-Glass), zirconium dioxide is introduced in the glass composition. However, the melting of high-content zirconia requires a significant quantity of energy, and fiberizing-related issues may occur due to the high viscosity of molten glass. In this study, the surface of E-glass fibers is dip-coated with ZrO_2 nanoparticle solutions to achieve high mechanical strength and alkali resistance in a fast and cost-effective method. Tensile characteristics of coated fibers were investigated using the standard single-filament testing method, and up to 17% strength increase was observed. Moreover, ZrO_2 nanoparticle-coated fibers were found to be resistant in highly alkaline environments under 500 hours of aging.

Keywords

mechanical properties, e-glass fibers, alkaline resistance, tensile strength

BENAN AKCA[1], Seniz Türküz[2], Fevzi Baba[1], Batuhan Gündoğdu[3]
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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Utilizing Large Language Models for Predictive Analysis of Optical Properties in Low-E Glass Coatings Post-Heat Treatment

Abstract

Predicting the optical characteristics of low-emissivity (low-E) glass coatings post-heat treatment is pivotal for refining manufacturing processes and assuring the optical quality of the final product. Current research in this area remains insufficient. This research introduces a methodology utilizing deep learning for anticipating the optical properties of low-E glass coatings after heat treatment. We critically assess diverse architectural strategies to comprehend the intricate optical changes due to heat exposure. Additionally, we integrated coating-specific features into the model, leveraging the Bidirectional Encoder Representations from Transformers (BERT), a large language model. This process considers the sequential coating materials and their corresponding thicknesses. Our models were crafted and assessed with a dataset comprising optical readings of low-E glass coatings before and after heat treatment. The performance for post-treatment spectra predictions was appraised on a distinct set featuring multiple coating designs. Our findings underscore the efficacy of the devised models in reliably forecasting the optical traits of low-E glass post-treatment. Infusing the model with coating-specific details and the use of the BERT large language model notably augments its prediction capability. This research not only addresses a significant scholarly void but also provides pragmatic insights for the glass industry, facilitating manufacturers in enhancing quality assurance and evolution of low-E glass coatings via precise optical prognostications.

Keywords

deep learning, optical predictions, low-emissivity (low-E) glass coatings, bidirectional encoder representations from transformers (BERT), heat treatment

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Towards the Silica Glass-Fiber Reinforced Composites for Aerospace Applications

Abstract

Extensive research has been done to produce high-performance composite materials as a result of the demand for sophisticated materials in aerospace applications. Pure silica fibers have become an attractive candidate due to their remarkable mechanical, thermal, and dielectric qualities. Silica fibers, that provide high tensile strength, low thermal expansion, resistance to extreme temperatures, and low dielectric constant, are great candidates for various aerospace composites. In order to produce pure silica fibers, there are several production steps and important factors that must be taken into account. In this work, we have developed a new method to produce glass-fibers for aerospace applications. The method covers the drawing of single-filament glass-fibers from a silica preform by utilizing oxy-hydrogen flame with automated feeding and collecting systems. Fibers as small as 100 µm diameter was successfully drawn with a continuous length of 5 meters by a cost-effective method to satisfy the growing demands of the aerospace industry.

Keywords

silica glass fibers, fiber reinforced composites, glass fiber manufacturing

DENİZ KOÇYİĞİT[1], Melis Gökçe[2], Aytaç Gökçe[2]
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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Photoluminesence Enhancement of Dy Ag Codoped Sodium Alumina Borate Glass: Effect of Heat Treatment

Abstract

Glasses with metallic nanoparticles (NPs) are of great interest in various applications such as photonics, nanotechnology and solid-state lighting technology due to their ability to improve the luminescence properties of rare earth ions. The sodium alumina borate glass was synthesized by conventional melt-quenching method and heat treated at a specific temperature of 500°C with different heat treatment durations of 2, 6, and_ 10 hours to ensure the formation and growth of Ag nanoparticles. The XRD pattern confirms the amorphous nature of the material. Raman analysis verified the existence of [BO3] and [BO4] groups with B-O stretching vibrations in the titled glasses. From the transmission electron microscope measurements, it was determined that the average Ag nanoparticle size grew with the increase in the heat treatment duration. The calculated bonding parameters suggest the ionic bonding character of Dy3+ ions and surrounding ligands. The most intense emission and excitation bands of Dy3+ ions were observed in the 6h heat-treated sample and then reduced with increasing heat treatment duration owing to the quenching effect. The photoluminescence spectra show highly intense blue and yellow emission bands at about 483 and 573 nm related to 4F9/2→6H15/2 and 4F9/2→6H13/2 transitions, respectively. As functions of heat treatment duration and excitation wavelength the yellow/blue ratios, Commission Internationale d'Eclairage color coordinates, and correlated color temperatures were evaluated using the photoluminescence spectra of Dy-Ag doped sodium alumina borate glasses. The results obtained from this study showed that Dy3+ and Ag+ doped sodium alumina borate glasses could be potential candidates for optoelectronic and photonic applications.

Keywords

sodium alumina borate glass, Ag nanoparticle, Dy3+ ion, heat treatment, photonic, photoluminescence

EKATERINA TRUSOVA, Angelina Terechuk
Belarusian State Technological University, Belarus

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Luminescent Glass Materials

Abstract

Currently, luminescent glass materials find wide application in increasing efficiency of solar panels, near infrared luminophores, optical fibers and sensors, laser equipment components. This is primarily due to formation of unconventional optical properties of the nanostructured glass materials, chemical and temperature stability, and, most importantly, due to ability to control the optical properties and structural characteristics of the nanoparticles during the process of their synthesis. In recent years there has been a significant rise in scientific papers related to the development and research of various types of oxyfluoride nano-glass-ceramics. The interest in these materials is primarily due to the prospect of their use as up- and down-converters, which results in the diversity both of compounds and of their application. The properties of PbO–PbF2–CdF2–YbF3–GeO2–SiO2 system glasses activated by Ho3+ and Tm3+ ions with different concentration were studied and transparent nano-glass ceramics based on them was received. The properties of crystalline phases being formed, and parameters of nanoparticles being formed in heat-treated oxide fluoride glasses doped with holmium and thulium ions was studied by small-angle X-ray neutron scattering technique. PbF2: Tm-Ho 16–20 nm nanoparticles formation and increase of glass density fluctuations average size from 71 to 92 nm was established. The obtained nano-glass ceramics determines high luminescence yield.

Keywords

luminescent glass, transparent nano-glass ceramics

EVREN TOPTOP[1], Seniz Türküz[2], Sinem Eraslan[2], Mustafa Gündoğdu[3], Hayriye Korkmaz[1], Ahmet Baba[1]
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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Accelerating Optimal Optical Solution Search: Deep Learning Framework-Based Simulator for Coated Glass Systems

Abstract

Functional coatings with multilayered structures are being used by the glass industry to obtain specific behavior in glass systems. For instance, low emissivity and solar control features are being engineered with the use of multilayered thin films in architectural and automotive applications. Population based optimization algorithms are the conventional method to solve the inverse design problems in coated glass systems, yet these models take substantial amounts of time for optimal solutions. Recently, deep generative models and deep reinforcement learning-based models, focusing on electromagnetic optics simulators for the optical behavior of the multilayered optical structure, became candidates to be alternatives for obtaining fast solutions without violating the constraints and error margins. In this study, we present an application of a novel simulator, developed with the state-of-the-art deep learning libraries. The proposed simulator is implemented on an open source "Scatter Matrix Method" software using Pytorch tensor operations framework with a multi-dimensional approach. Simulators' performances are calculated for varying sample sizes from being single to ten thousand. The solution speed of the proposed model was compared with conventional methods that use linear-algebra libraries. Pytorch multi-dimensional model performed with a single sample yield about 3.15-fold speed improvement over the baseline. Notably, Pytorch-based multi-dimensional simulator provides even more significant speed improvements with the increasing sample sizes. The speed improvement for 100, 5000 and 10,000 samples were 3.2, 4.28 and 8.57, respectively. This study shows that deep learning frameworks such as Pytorch mitigate the linear algebraic calculation loads in search of optimal optical solutions.

Keywords

functional coatings, multilayered optical structures, optimal solution search, electromagnetic optics modeling and simulation, scatter matrix method, deep learning frameworks

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Optimal Design of Multilayered Glass Coatings using Genetic Optimization Algorithms for Enhanced Optical Performance

Abstract

The glass industry uses functional coatings for several applications. Features such as low emissivity and solar control are primary use cases in architectural and automotive applications. Various possibilities of layered materials with variable thicknesses result in a vast search space to find an optimal configuration corresponding to a specifically desired system performance. Such a complexity makes developing a generic method rather difficult. To address the complex issues in designing an optimal coating configuration, we propose a genetic optimization algorithm-based approach. Genetic optimization algorithm was employed to find the optimal thickness set for several configurations of a fixed set of material sequences, to achieve the desired optical performance. The main targets are taken to be the industrial performance metrics calculated according to the international standard manuals. Targeting these metrics alone with the objective function of minimization the sum of absolute errors, suffered from the undesired oscillatory, rippled or shifted spectral behavior. To overcome such undesired effects, we used to guide spectra and weigh the errors of targeted metrics, thereby maintaining their importance against the total error in spectra. Our experiments revealed that the proposed method can accurately design a 6 layered configuration with an error of less than 1%, satisfying the necessary error margin in industry standards. Moreover, for 7 to 16 layered configurations, the proposed solutions' target metrics have a good accordance with the desired properties, having errors within the range of 1% and 5%. The proposed approach uses model spectra data for guidance to avoid oscillations and weighted errors for target metrics to reach the satisfying optimal thicknesses, that it is likely to overcome the obstacle of having undesired spectral behaviors, especially in the visible region where the spectral responses can be wavy.

Keywords

functional coatings, multilayer optical structures, inverse design, genetic optimization algorithms

GÖKTUĞ GÜNKAYA, Ayşenur Sarı
Anadolu University, Türkiye

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Mold-Making Technique and The Investigation of the Effect of Thermal Processing on Opaque White Glass by Mold-Making for Glass Artworks

Abstract

This study aims to investigate the mold-making technique used in glass art and particularly the effect of thermal processing on opaque white glass by mold-making. Various effects dependent on color tones and surface textures that could occur in the glass have been observed through thermal process conducted in a kiln. It has been determined that controlled thermal processing applied in relation to temperature can lead to the attainment of different glass colors and textures. The utilization of a single commercially sourced glass composition to achieve diverse glass colors and textures emerges as an effective parameter for use in the production of glass artworks. The results provide insights for glass artists and designers on how to integrate the mold-making technique into their creative processes and how the use of opaque white glass can be optimized. Additionally, based on these insights, a three-dimensional glass artwork has been created.

Keywords

mold-making for glass, color change of glass by temperature, artistic glasswork, molded glass

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Prediction of Low Emission Parameters of Nano-coated Glass with Deep Neural Networks

Abstract

Nano-coated glasses are used in a wide range of optics, electro-optics, micro-electronics, especially in architectural structures and automotive industry. Nano-coated glasses produced by using thin-film technologies are exposed to the heat treatment process in temper furnaces to reach the final product form. This two-stage process leads to changes in the electrical, mechanical and low emission parameters of the resulting product. This makes difficult to predict the parameters after the heat treatment process by analytical and numerical methods. In previous studies, measurements from whole spectral range were used for the estimation of low emission parameters. In this study, a new model was developed by dividing the spectral range into two parts: 1)380-980 nm and_ 2)985-2500 nm. The same data set was used to be able compare the prediction success for both model. In the machine learning model using splitted spectra, closer values were obtained to the actual ones. The use of splitted spectrum was evaluated as more effective to get the final parametres by experts.

Keywords

nano-coated glass, deep neural networks, machine learning

HAMID REZA BAHARI, Bülend Ortac, Umut Taylan
Bilkent University UNAM, Türkiye

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Green Synthesis of Glass-Incorporated Nanostructures by Direct Pulsed Laser Ablation in TEOS Media

Abstract

In this talk, we present a green laser-based non-Stober method of fabrication of glass-inclusive complex nanostructures out of the silica source solution phase. The technique is to use a series of femtosecond laser ablation/fragmentation processing of ceramic/metal materials in diluted TEOS media with no other Stober chemicals in order to synthesize metal and/or ceramic nanoparticles embedded in a glass matrix (or glass shell). The technique is successfully tested on Rare-Earth doped upconverting nanoceramics (UCNPs), and Ag nanoparticles with glass isolating layer and a range of 5 to 30 nm nanoparticles embedded in the glass (nano-glass droplets) were achieved. Photoluminescence and Photothermal properties of the fully laser-processed nano-complex have been studied for applications in bioimaging and photothermal therapy.

Keywords

nanoglass, laser ablation, TEOS, non-stober, green synthesis

MAHSHAD AZIMA, Senem Seyis
Özyegin University, Türkiye

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Adaptive Solar-Active Glazing Concept

Abstract

The construction industry has recently taken notice of the use of fully glazed façades. It is worth noting that fully glazed facades provide visual and daylight comfort, which can lead to not only occupant satisfaction but also a reduction in electricity demand. As a result, in addition to the benefits mentioned above, latent heat load and proper shading strategies need to be considered. The goal of this invention is to improve thermal and occupant comfort while assisting in the development of building energy performance as a service-driven solution that addresses the benefits of adaptive and solar active façade. The present invention composes three layers (1). The outer (10) and inner layers (20) are glazing material while the layer in the middle has been designed as horizontal flaps (31). The flaps are covered with solar cells (32) for electricity generating form sunlight during daytime. The flap is automated and sensitive to sunlight radiation, acting as dynamic shading while providing occupant comfort without visual limitation. The advantage of this invention is on sunlight-heated air that exists between said inner layer (10) and said outer layer (20). One compressor (36) and feeder (37) have been positioned between layer to circulate the heated air with air in the system to heat the water tank (38). This invention has the potential to improve energy performance and daylight performance. Additionally, this invention can be used as an onsite renewable energy source to partially meet the energy demand of a building. This research has the potential to improve sustainability in urban design for modern cities by contributing to the performance-based design of building with vast window-to-wall ratio.

Keywords

fully-glazed building, solar-active window, adaptive envelope, energy efficency

MIHAIL DYADENKO, Ivan Levitskii
Belarusian State Technological University, Belarus

Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Borosilicate Glass for Coatings Fiber Optic

Abstract

There are two types of fiber-optic products, i.e., those from flexible and rigid optical fiber. This paper dwells upon fiber-optic products from rigid optical fiber. Rigid optical fiber is a system consisting of a light-guiding core, reflective and protective coatings. In the Republic of Belarus, rigid optical fiber produced at JSC "Optic Plant", Lida. This work provides information about the development of a pair of optical "light crown" glasses for rigid optical fiber coatings. The $R_2O–B_2O_3–SiO_2$ system is the basis for the development of glass with a low refractive index used in the production of rigid optical fiber as reflective and protective coatings. The effect of the chemical composition of borosilicate glass and boron coordination on the temperature coefficient of linear expansion and viscosity has been determined. The effect of glass composition on viscosity temperature index in the range of 109–105 Pa•s has been studied. The effect of concentration and structural factors on viscosity fluctuation in $Na_2O–K_2O–B_2O_3–SiO_2$ glass in the range of 109–105 Pa•s has been established. The effect of boron and potassium oxides on the viscosity temperature index is very complicated in the "plastic–to–liquid" transition phase. The structure of experimental glass has been studied by infrared spectroscopy. The regularity of structural groups has been described to changing structural parameters of K and R. The established relations between TCLE and viscosity of glass and their chemical compositions make it possible to select compositions that will be used as coatings in the production of rigid optical fiber by "stack–tube" method, ensuring its thermomechanical strength and conformity to rheological parameters.

Keywords

borosilicate glass, reflective coating, light crown, refractive index, viscosity, temperature coefficient of linear expansion, structure

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
Time	17:10 - 18:00 (Istanbul time, CET+02:00)

Influence of TeO_2, V_2O_5 AND Bi_2O_3 on the Electrophysical Characteristics of Glass

Abstract

The influence of TeO_2, V_2O_5 and Bi_2O_3 oxides on the electrophysical characteristics of aluminosilicate glass at frequencies of 100 Hz, 1 kHz and 10 kHz has been established. The maximum electrical conductivity is observed in glass modified with TeO_2 in an amount of at least 7.5 mol. % in the entire range of the studied frequencies. The attenuation of the microwave energy by the material depends on the magnitude of the imaginary component of the dielectric constant. At frequencies, the values of the real parts of which are much higher than the imaginary ones, the absorption will be minimal, and in this case the material will be transparent to microwave radiation (radio-transparent). According to the results obtained, it was found that in tellurium- and vanadium-containing glasses, ε'' completely exceeds ε' at frequencies of 1 and 10 kHz. To ensure significant penetration of electromagnetic waves into the material, an optimal combination of moderate values of ε' must be observed, and for effective absorption of microwave energy in the volume of the material, there must be a high loss coefficient ε''. Thus, the maximum loss coefficient at a frequency of 100 Hz is characteristic of tellurium-containing glasses, while its value increases with an increase in the content of the injected oxide. Tellurium oxide has a similar effect at frequencies of 1 and 10 kHz, while the curves are characterized by the presence of a maximum at the content of TeO_2 and V_2O_5, which is 7.5 mol. %. In addition, the regularity of the change in the tangent of the dielectric loss angle has been established: in the case of tellurium-containing glasses, the dependence of the tgε index on the amount of oxide introduced is nonlinear and is characterized by a maximum value at a TeO_2 content of 7.5 mol.%.

Keywords

electrophysical characteristics, electromagnetic radiation, tellurium-containing glasses, attenuation of the electromagnetic radiation, permittivity

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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Numerical Thermal Analysis of Glass Annealing Process: Effect of the Height-to-Diameter Ratio of Container Glassware on the Cost of the Process

Abstract

Annealing is used to relieve the residual thermal stresses that arise due to rapid cooling of molten glass. In the context of container glass manufacturing, annealing is performed in continuous annealing furnaces where the container glassware is first heated to the annealing temperature and subsequently cooled down at a carefully adjusted rate. In these furnaces thermal radiation plays a major role in the heat transfer between the glass and furnace walls. However, the effectiveness of the radiation heat transfer also heavily depends on the geometry of the glassware itself. In this study, the effect of the height and diameter of cylinder-shaped glassware on the heating and cooling behavior of the glassware were numerically investigated. Simulations were conducted using the in-house developed solver. The developed solver consists of two sub-solvers. The first sub-solver is responsible for solving the transient heat conduction equation within the moving glassware on the conveyor belt in the furnace. It considers both radiative and convective heat fluxes as boundary conditions on the glass surface. The second sub-solver solves for the convection and radiation heat transfer inside the furnace with the given inputs from the other solver. To reduce the computational cost of the second sub-solver, the glassware rows in the furnace are modeled as a porous zone with the porosity parameters tuned from highly resolved single glassware simulations. Running both solvers in an iterative approach, a detailed temperature field of the glassware inside the furnace and the radiation and convective heat fluxes on the glass surfaces are calculated. Numerical results indicate that the reduced effectiveness of the glassware with high height-to-diameter ratio due to the shadowing effect. Finally, implications of this geometrical factor on the required duration of the annealing process and on the cost of the process are discussed.

Keywords

annealing, heat transfer

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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SiOC Aerogel Glass for Wastewater Purification

Abstract

Porous materials have been of great interest for wastewater treatment, filtration (gases, liquids, molten metals), and thermal insulation. In the present work, highly porous silicon oxycarbide (SiOC) black glass aerogels were synthesized using commercially available polysiloxane resin. First, the preceramic gels were formed via cross-linking, followed by a drying via ambient pressure (ambigels) or under CO_2 supercritical (aerogels). Finally, high temperature pyrolysis yielded with SiOC glasses. The high speficic surface area porous components were characterized by an in-depth microstructural and chemical investigation. The samples had around 80 vol% total porosity with 900 $m^2.g^{-1}$ specific surface area and the pore volume reaching 5 $cm^3.g^{-1}$.

Keywords

SiOC aerogel glass, supercritical drying, wastewater treatment

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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Batch Tracking is Next Step in Digitalisation

Abstract

The IMAGEPro Version 2 is a PC-based software with the ability to provide batch coverage functions and additionally to communicate natively with modbus, TCP and OPC UA, already covering a large part of the industrial protocols in the glass industry. Operators can also check the visual information coming from the NIR-B-2K-Glass interface but can also use different information and connect the thermal imager to any PLC using a data acquisition and protocol conversion platform for DCS or SCADA control. Managing the batch length to control the crown temperature is becoming easier. For batch monitoring and furnace control of a glass furnace to be most effective, the NIR-B-2K-Glass camera with the flexible IMAGEPro software should be integrated into the DCS control of the furnace and be connected to the existing PLC to provide data to a SCADA. The AMETEK Land NIR-B-2K-Glass infrared borescope with IMAGEPro is the ideal tool for this. Ametek LAND's NIR-Borescope-2K-Glass infrared thermal imaging camera delivers high-definition images, with accurate temperature measurements at any of the three million temperature points in the thermal image providing accurate temperature profiling and continuous furnace monitoring for any set-up based on data exchange for SCADA. Additionally, the application of relative isotherms within the image offers the ability to see which flames are typically hotter and give an indication of the flame length. Then, the NIR-B-2K combined with Lancom 4 (our portable gas analyser with 9 gases including O2 and CO2 is a perfect match to lower the carbon footprint and reinforce energy reduction.

Keywords

batch tracking, digitilization, energy efficiency, emission reduction

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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A Numerical Study on the Effect of Foam Layer on the Refining Characteristic in a Glass Melting Furnace

Abstract

Refining is an important process in glass melting since significant amounts of gas bubbles are formed as a result of batch melting and these gas bubbles should be evacuated for the sake of final product quality. Bubble presence in the glass bath also interferes with the radiative heat transfer behaviour through the glass bath. Also, a foam layer can be form on the top surface of the glass bath as an accumulation of the gas bubbles inside, and it strongly affects the physical events in the glass bath. To address these, a numerical investigation of the glass melting process in an industrial furnace is conducted. A numerical model is obtained for both combustion and glass bath zones in Ansys Fluent solver. They are solved separately and then coupled by transferring the temperature and heat flux data of their sharing boundaries to each other and solved iteratively. In the glass bath zone, batch melting submodel is also discussed and implemented in the model to obtain a realistic model. In the combustion zone, the Weighted Sum of Gray Gases model is employed for modelling radiation heat transfer. Results are compared with existing experimental measurements. Refining characteristics and its relation with radiation heat transfer inside the glass bath is discussed. Presence of the gas bubbles and its effect on temperature distribution within the glass bath is analysed. A foam formation scenario is also discussed and implemented in the existing numerical model. The temperature distribution and the convection currents with and without the formation of the foam is numerically calculated.

Keywords

glass melting, radiative heat transfer, iterative scheme, numerical, bubbles

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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Silver Nanowire Networks Based Functional Oxide Thin Films for Smart Windows

Abstract

Buildings are responsible for almost 36% of the world's energy consumption. Therefore, a popular focus area includes smart and innovative materials for improved building energy efficiency. Glass is an important part of building construction. The inherent structural disadvantage of glass as a building material is that it can't limit the amount of heat and radiation passing through it. But designing and combining glasses with various smart materials can reduce heat irradiation and achieve a balanced area climate. While using thermo and electro-chromic materials in smart windows is a promising technology, it is not yet widely adopted in commercial buildings due to its relatively high cost compared to other window technologies. In this study, cost-effective and alternative research on the syntheses and application of all solution-based chromogenic materials to increase energy efficiency in buildings are presented with step-by-step comparable processes. Silver nanowire (Ag NW) networks are utilized as transparent conductive electrodes due to their excellent transparency and minimal haze in the visible spectrum, low sheet resistance, and vacuum-free deposition. Electrochromic devices with glass/AgNWs/WOx/LiClO4-PC-PMMA gel electrolyte/NiO/AgNWs/glass structure are fabricated using all solution-based processes, where ultrasonic spray deposited WOx and NiO are used as electrochromic layer and ion storage layer, respectively. For the thermochromic devices, Ag NWs are used as thin film heaters and vanadium oxide (VO2) was used as a reversible metal-insulator transition layer in the VO2(M)/glass/Ag NWs structure. Optoelectronic, electrochemical, structural, and morphological properties of the films and devices are investigated in detail. Acknowledgments: This work was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) with Grant no. 121N708.

Keywords

silver nanowire, thermo and electro-chromic materials, smart windows

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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Influence of Granulometric Composition of Carbonate Rocks on Glass Formation Processes

Abstract

Rational choice of the granulometric composition of raw materials is one of the important challenges of glass production. The grain size of batch components influences the speed of the processes of silicate and glass formation as well as the speed of the batch mixing processes and the charge homogeneity. There is no uniform approach to the choice of the grain composition of the carbonate rocks (limestones, dolomites). Therefore, a study was conducted on the influence of the granulometric composition of the carbonate rocks with fractional composition of 0.1–1.0 mm; 1.0–1.6 mm; 1.6–2.5 mm – on the processes of glass formation during float glass production. Kinetics of the decarbonization of the dolomites and limestones with various fractional compositions was studied by thermal analysis and gasometric method. Time of the thermal dissociation of carbonates at the temperatures of 900 _and_ 1000°C is 100–300 s. Dependence of the degree of decarbonization on the particle's dispersion and the time of the heat treatment was established. The energy for the dissociation process activation is 215–250 kJ/mole for the limestones and_ 87–182 kJ/mole for the dolomites. The highest energy values of decarbonization process activation have been found in 1.0–1.6 mm fraction. At the temperature range of 900–1100°C at the boundary of grains containing CaO and MgO, interaction of batch components occurs with the formation of sodium silicates, magnesium, and calcium with non-stoichiometric composition. Consequently, the increase of the size of carbonate grains results in the decrease in activity of silicate formation processes. However, when the carbonates decompose, their grains acquire porous structure, microfractures appear, which increases their reactivity and reduces the influence of the grain size. Glass production processes in all the samples of the batch received with the use of carbonate rocks with different granulometric composition end at the heat treatment temperature of 1400°C.

Keywords

carbonate rocks, glass formation, float glass

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Session	POSTER
Date	NOVEMBER 2, 2023, Thursday
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Devitrification and Phase Separation of Borosilicate Glasses Containing TiO_2 and ZrO_2

Abstract

This work reports crystallization and phase separation of an alkali resistant glass composition in the $Na_2O–CaO–Al_2O_3–B_2O_3–SiO_2$ system with addition different amounts of ZrO_2 and TiO_2. At first, based on previous studies, the base composition was selected and then glass specimens prepared by melting of raw pure materials and above-mentioned additives in an alumina crucible at 1400°C For 3 hrs. and casting in a metal mold. Additives were added in constant values of 2.5 and 3.5 mole%. XRD analysis was carried out to ensure that no crystalline phases are formed. Then heat treatment was performed in temperature intervals of 620, 650, 680 and 710°C. SEM was used to phase separation study, the samples were imaged using electron microscopy (SEM). The tendency of crystallization decreased with increasing the amount of ZrO_2 due to increase in viscosity. By increasing the amount of TiO2 in the mother glass, phase separation was achieved, and crystallization occurred in samples containing molybdenum oxide. In the next step, the acid leaching process of phase separated glasses was performed. Porosity analysis and measurement of specific surface area of BET were performed on acid leached samples. The results show that the highest porosity volume was related to the samples containing zirconium oxide with three steps acid washing and the sample containing TiO_2 with two steps acid washing. The lowest was obtained in samples containing titanium oxide and samples containing ZrO_2 with two acid washing steps. Based on the specific surface results, the highest specific surface area was obtained for the sample containing zirconium oxide with three acid washing steps (23.78 m^2 / g) and the lowest for the sample containing zirconium oxide with two acid washing steps (2.27 m^2 / g).

Keywords

borosilicate glasses, phase separation, TiO_2, ZrO_2

Tourist Information

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

Health & Safety
Emergency telephone number: Medical 112

Climate and Clothing
In late November, the weather in Istanbul is generally cool and slightly overcast. Daily temperatures average at 18 oC (64 oF). 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 2000 to TL 3000 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. Atatürk 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.

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