40th ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

UNITED TO INNOVATE

A Future-Focused Transformation of Energy & Glass

18-19 June 2026
İSTANBUL

ŞİŞECAM PIONEERING R&D AND INNOVATION | 50 YEARS

ŞİŞECAM

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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.

CONTENTS

Dear Colleagues and Esteemed Guests,

In 1985, Şişecam set out with a bold vision and launched its first Glass Conference to spark innovation and help shape a stronger, more connected global glass ecosystem. What began as a pioneering initiative has grown into a powerful platform where ideas converge, boundaries are pushed, and the future of glass is continuously reimagined.

Today, as we celebrate 50 years of excellence in R&D, we do so with a spirit that remains relentlessly forward-looking. Powered by deep scientific expertise, advanced technologies, and a culture of innovation, we are not only responding to the needs of today—we are actively designing the possibilities of tomorrow.

With one of the most comprehensive R&D infrastructures in our industry, we are redefining the role of glass across sectors—from energy to mobility, from architecture to sustainability, unlocking its full potential as a material of the future.

As we mark this milestone, we are proud to host the 40th Şişecam International Glass Conference under the theme "United to Innovate: A Future-Focused Transformation of Energy & Glass."

This is more than a conference—it is a call to collaborate, to accelerate transformation, and to lead the next era of innovation together. Bringing together some of the world's most influential scientific and industry voices, this platform is where ideas become action and vision turns into impact.

We are delighted to have you with us on this journey and we look forward to shaping the future of glass, together.

Can Yücel
Conference President
Chief Executive Officer
Şişecam

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40th ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

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PROGRAM AT A GLANCE

18-19 JUNE 2026 İSTANBUL

CEST + 1	JUNE 18, 2026	
09:00 - 09:30	REGISTRATION & COFFEE BREAK	
	HALL-1	
09:30 - 09:50	OPENING SESSION	
09:50 - 10:30	KEYNOTE SESSION	
10:30 - 12:00	PANEL SESSION	
12:00 - 13:00	LUNCH BREAK	
	HALL-1	
13:00 - 13:40	KEYNOTE SESSION	
13:40 - 14:25	FIRESIDE CHAT	
14:25 - 14:45	COFFEE BREAK	
	HALL-1	HALL-2
14:45 - 16:35	ENERGY TRANSFORMATION	INNOVATION
16:35 - 16:55	COFFEE BREAK	
	HALL-1	HALL-2
16:55 - 18:35	ENGINEERING	COATING & SURFACE
18:35 - 19:45	POSTER SESSIONS & COCKTAIL	

CEST + 1	JUNE 19, 2026	
	HALL-1	
09:00 - 10:10	PANEL SESSION	
10:10 - 10:30	COFFEE BREAK	
	HALL-1	HALL-2
10:30 - 12:20	DIGITAL & ARTIFICIAL INTELLIGENCE	GLASS SCIENCE
12:20 - 13:20	LUNCH BREAK	
	HALL-1	HALL-2
13:20 - 15:30	DECARBONIZATION	DESIGN
15:30 - 16:10	KEYNOTE SESSION	
16:10 - 16:20	Closing	

40th ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

UNITED TO INNOVATE

SCIENTIFIC PROGRAM

18-19 JUNE 2026 İSTANBUL

40TH ŞİŞECAM INTERNATIONAL GLASS CONFERENCE
"United to Innovate: A Future-Focused Transformation of Energy & Glass"

CEST + 1	Hotel Raffles Istanbul, Türkiye
08:30 - 09:30	**REGISTRATION & COFFEE BREAK**
	June 18, 2026
ROOM	**Hall-1**
09:30 - 09:50	**Opening Session**
09:50 - 10:30	Challenges and Opportunities for The European Flat Glass Industry in The Sustainability and Energy Transition **Davide Cappellino** President, AGC Architectural Glass Europe & Americas, Glass For Europe, BE ONLINE
10:30 - 12:00	**Panel Discussion:** How the Glass Innovation and Technology Ecosystem Works: From Discovery to Industrial Transformation **Erik Muijsenberg** (ICG, CZ), **Oscar Verheijen** (Celsian, NL), **Dominik Orzol** (IPGR, DE), **Justin Kelly** (Glass Futures, UK)
12:00 - 13:00	Lunch Break
13:00 - 13:40	**Global Energy Transformation** **Dr. Fatih Birol** Executive Director, International Energy Agency (IEA), FR
13:40 - 14:25	**Fireside Chat:** Securing the Transition: Financing the Decarbonization of Energy-Intensive Industry **Dr. Fatih Birol** (International Energy Agency (IEA), FR), **Gianpiero Nacci** (EBRD, UK)
14:25 - 14:45	Coffee Break

ROOM	**Hall-1**
MAIN SESSION	**Energy Transformation**
CHAIR	**Volkan Demirdağ** (Energy Management Director, Şişecam, TR)
RESP. MEMBER	**Gamze Aydın** (Energy Category Supervisor, Şişecam. TR)
14:45 - 15:15	Empowering Energy Transition: Innovations in Safe, Efficient & Accessible Battery Storage **Zhiying Zhou** (GreatPower, CN)
15:15 - 15:35	Decarbonization with Nuclear Energy **Assoc. Prof. Dr. Senem Şentürk Lüle** (Istanbul Technical University, TR)
15:35 - 15:55	Beyond the Furnace: Energy Transformation Across the Glass Plant **Cathalijn van Rijmenam & Mert Kalpar** (Siemens AG, DE)
15:55 - 16:15	Scaling up Perovskite Solar Technologies towards Gigawatt-Manufacturing with Vacuum Deposition Technology - A Western European Perspective on Next Generation Photovoltaics **Martin Fischer** (Von Ardenne, DE)
16:15 - 16:35	Melter Electrification and Competitiveness – Solving Challenges Across Glass Sectors and Geography **Bruno Malphettes** (Fives Stein, FR)
16:35 - 16:55	Coffee Break

ROOM	**Hall-2**
MAIN SESSION	**Innovation**
CHAIR	**Dr. Burak Okan** (Advanced Surface & Coating Technologies and New Materials Manager, Şişecam, TR)
RESP. MEMBER	**Dr. Tuncay Turutoğlu** (Flat Glass Product Development Manager, Şişecam, TR)
14:45 - 15:15	Innovative Vacuum Insulated Glass Manufacturing: Low-Temperature Metallic Sealing for VIG **Pekka E.J. Nieminen** (Leadustech, FI)
15:15 - 15:35	Advancing Surface Performance: Next-Generation Laser Micromachining for Glass Functional Finishes **Dr. Sabri Alamri** (Fusion Bionic, DE)
15:35 - 15:55	Next-Generation Smart Windows: Efforts Towards the Development of Smart Windows for Sustainable Energy Applications **Dr. Ashutosh Singh** (CeNS, IN)
15:55 - 16:15	Optical Modulation and Functional Performance in Smart Glazing Technologies **Berk Alkan** (Şişecam, TR)
16:15 - 16:35	Driving the Future of Smart Glazing: How Switchable Films and IR Coatings Will Redefine Light, Comfort, and User Experience **Han-Alexander Pothoven** (DK Automotive Glass, NL)
16:35 - 16:55	Coffee Break

ROOM	Hall-1
MAIN SESSION	**Engineering**
CHAIR	**Özgür Balcı** (Glass Forming Technologies Manager, Şişecam, TR)
RESP. MEMBER	**Kemal Külcü** (Auto Glass Process Technologies Manager, Şişecam, TR)
16:55 - 17:15	Solar Glass Manufacturing - State of the Art, Technological Developments and Future Challenges in Furnace Design **Ralf Czeschka** (SORG, DE)
17:15 - 17:35	Enabling Lightweighting Without Compromise: Securing the Future-Focused Transformation of Energy and Glass **Romain Pioch** (TIAMA, FR)
17:35 - 17:55	LIFE SUGAR Project – First Industrial Test Results **Ernesto Cattaneo** (Stara Glass S.p.A, IT)
17:55 - 18:15	Oxygen-Based Solutions to Enhance Utilization of Aging Container Glass Furnaces **Matthias Goerisch** (Linde GmbH, DE) ONLINE
18:15 - 18:35	Double-Digit Energy Savings with New Batch and Cullet Technologies **Volker Maier** (Zippe Industrieanlagen GmbH, DE)
18:35 - 19:45	Poster Sessions & Cocktail

ROOM	Hall-2
MAIN SESSION	**Coating & Surface**
CHAIR	**Dr. Tuncay Turutoğlu** (Flat Glass Product Development Manager, Şişecam, TR)
RESP. MEMBER	**Anıl Özen** (Glassware & Glass Packaging Product Development Manager, Şişecam, TR)
16:55 - 17:25	Data-Driven High-Throughput Experimentation for Materials Discovery **Dr. Lars Banko** (XEMX Materials Space Exploration GmbH, DE)
17:25 - 17:45	Broad Beam Plasma Source Enhanced Thin-Film Growth **Prof. Dr. Qi Hua Fan** (Michigan State University, US) ONLINE
17:45 - 18:05	In Silico Optimization of Low-E Coatings with Reduced Silver Consumption: From Atomic to Industrial Scale **Dr. Jerome Müller** (Sol4U, BE)
18:05 - 18:25	High Entropy Alloy Thin Films as Multifunctional Coatings for Glass: Synthesis, Microstructure, and Surface Properties **Assoc. Prof. Dr. Uğur Ünal** (Koç University, TR)
18:25 - 18:45	Challenges & Developments for Glass Protection **Charly Hoebers** (Nitto, BE)
18:45 - 19:45	Poster Session

40TH ŞİŞECAM INTERNATIONAL GLASS CONFERENCE
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CEST + 1	**Hotel Raffles Istanbul, Türkiye**
08:30 - 09:00	**REGISTRATION & COFFEE BREAK**
	June 19, 2026
ROOM	**Hall-1**
09:00 - 10:10	Panel Discussion: From Lab to Scalable Innovation: The Journey of Entrepreneurship **Nicolas Fedullo** (AGC, BE), **Burak Arık** (Maxitech, US), **Dr. Sabri Alamri** (Fusion Bionic, DE)
10:10 - 10:30	Coffee Break
ROOM	**Hall-1**
MAIN SESSION	**Digital & Artificial Intelligence**
CHAIR	**Esra Yazıcı** (Data & Analytics Director, Şişecam, TR)
RESP. MEMBER	**Dr. Gökçe Yüce** (Digital Technologies & Simulation Service Manager, Şişecam. TR)
10:30 - 11:00	AI-Driven Optimization of Glass Production **Dr. Oscar Verheijen** (Celsian, NL)
11:00 - 11:20	Digital Transformation **Hervé Dumas** (Google, UAE)
11:20 - 11:40	End-to-End Digitalization as a Key Enabler for Sustainable and Efficient Glass Manufacturing **Magdi El-Awdan** (Siemens AG, DE)
11:40 - 12:00	System Intelligence Through Collaboration **Paul Schreuders** (XPAR Vision, NL)
12:00 - 12:20	Bridging The Competitiveness Gap: Physics-AI Digital Twins for Energy-Efficient and High-Performance Hollow Glass Manufacturing **Federico Monegaglia** (GlassForm, IT)
12:20 - 13:20	Lunch Break

ROOM	Hall-2
MAIN SESSION	**Glass Science**
CHAIR	**Banu Arslan** (Advanced Glass and Melting Technologies Manager, Şişecam, TR)
RESP. MEMBER	**Dr. Tuncay Turutoğlu** (Flat Glass Product Development Manager, Şişecam, TR)
10:30 - 11:00	Application and Potential of Microwave Heating for Energy Efficient Glass Technology **Prof. Dr. Sindy Fuhrmann** (Tu-Freiberg, DE)
11:00 - 11:20	Challenges in Atomistic Simulations of Amorphous and Glassy Materials **Prof. Dr. Alfonso Pedone** (University of Modena and Reggio Emilia, IT)
11:20 - 11:40	Mathematical Modeling of Heat Transfer and Batch-to-Glass Conversion Kinetics in Commercial and Waste Glass Melting **Prof. Dr. Richard Pokorny** (University of Chemistry and Technology Prague, CZ)
11:40 - 12:00	Conditioning of Glass Waste for Recycling via Glass Laser Morphing **Prof. Dr. Alicia Duran** (CSIC, ES)
12:00 - 12:20	New Generation Raw Materials **Liam Wray** (Calumite Ltd., UK)
12:20 - 13:20	Lunch Break

ROOM	Hall-1
MAIN SESSION	**Decarbonization**
CHAIR	**Özgür Acar** (Furnace & Combustion Technologies Manager, Şişecam, TR)
RESP. MEMBER	**Olgan Sarıçalık** (Batching & Mechanical Systems Manager, Şişecam, TR)
13:20 - 13:50	Decarbonization Pathway of the Glass: Industry, Challenges, Opportunities for Different Segments and Possible Solutions Regarding Different Energy Inputs **Erik Muijsenberg** (ICG, CZ)
13:50 - 14:10	LionGlass: from Research to Industrial Assessment of Low-Carbon Glass Compositions **Elisa Biavardi** (Bormioli Luigi, IT)
14:10 - 14:30	Next Generation Glass with Glass Futures: Building a Digital Furnace **Aston Fuller** (Glass Futures, UK)
14:30 - 14:50	Performance of High-Purity $MgO-Al_2O_3$ Spinel Refractories under Alkali-Rich and High-Humidity Conditions in Modern Glass Furnaces **Daniela Messina** (RHI Magnesita, IT)
14:50 - 15:10	Development of a Fused Cast AZS Refractory with High Electrical Resistance for Glass Furnaces **Roland P. Heidrich** (REFEL S.p.A., IT)

ROOM	**Hall-2**
MAIN SESSION	**Design**
CHAIR	**Değer Demircan Acılıoğlu** (Head of Design Center, Şişecam, TR)
RESP. MEMBER	**Dilara Birsen** (Mold Designer, Şişecam, TR)
13:20 - 13:50	The Ambition of Glass: Elevating Packaging, Brands and Experiences **Andrea Ucchino** (Studio One Eleven, Berlin Packaging, IT)
13:50 - 14:10	AI Manufacturing in Glass Design **Cüneyt Batmaz** (Microsoft, TR)
14:10 - 14:30	Shaping the Physical Identity of a Global Beer Icon **Janwillem Bouwknegt** (NPK Design, NL)
14:30 - 14:50	Branding and Packaging Design Trends **Dr. Orhan Irmak** (Orhan Irmak Tasarım, TR)
14:50 - 15:10	AI Accelerator Marketing & Design **Sebastian Schwartze** (BSH, DE) ONLINE
15:10 - 15:30	Design and Integration of Advanced New Technologies for Automotive Glass Production **Luigi Stigliano** (Independent Plant Eng. Sp. – Automotive Glass Production, IT)
ROOM	**Hall-1**
15:30 - 16:10	Outside to Inside - Inside to Outside **Murat Tabanlıoğlu** +MURAT TABANLIOĞLU Studio, TR
16:10 - 16:20	Closing

40th ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

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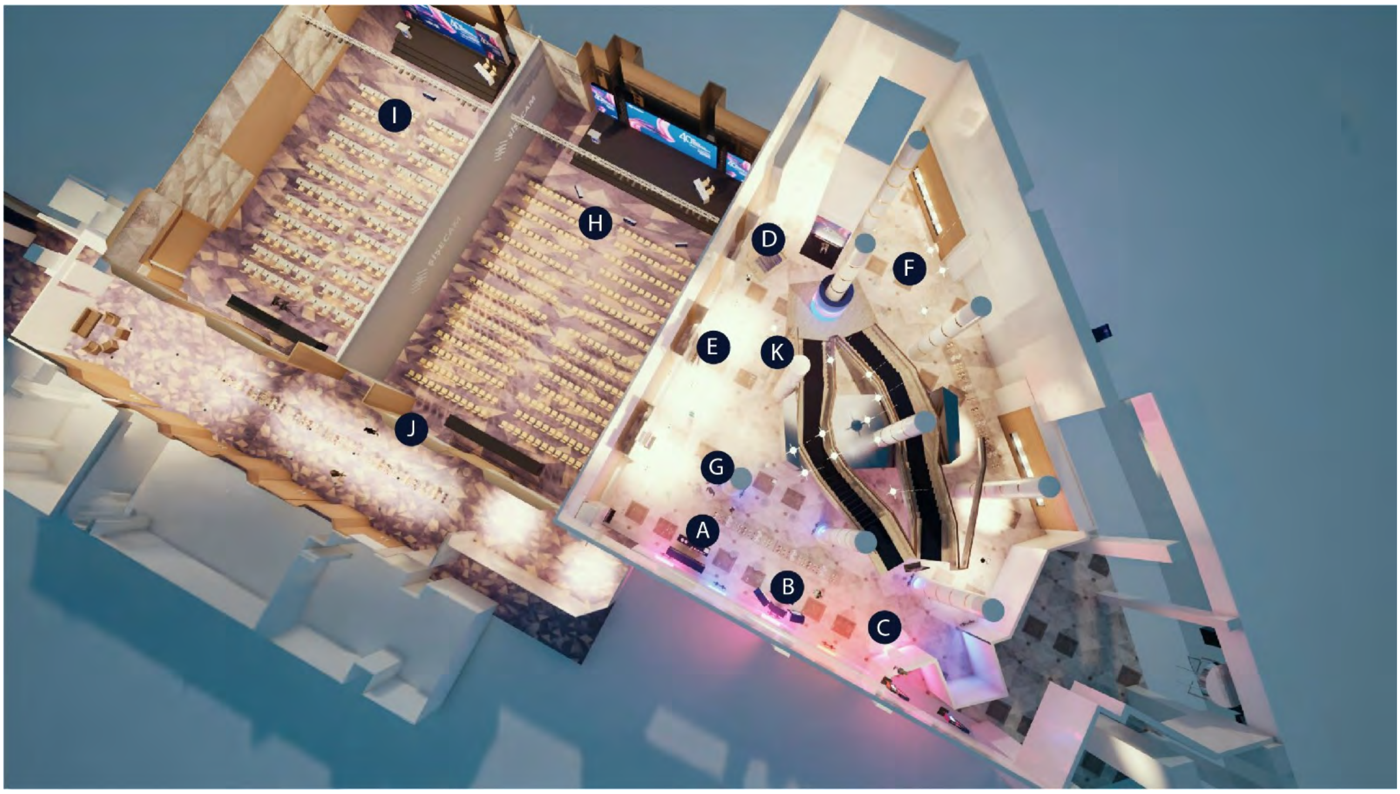
LOCATION OF ACTIVITIES

18-19 JUNE 2026 İSTANBUL



A - CHILL IN GLASS
B - AI COASTER DESIGN LAB
C - NUDE BAR
D - INSTALLATION AREA
F - LUNCH AREA
G - QUARTET
H - HALL1
I - HALL2
J - LUNCH AREA / POSTER SESSION
K - PDLC SMART GLASS - ULTRA LIGHTWEIGHT BOTTLES

KEYNOTE SPEAKERS

18-19 JUNE 2026 İSTANBUL

Global Energy Transformation

Dr. Fatih Birol

International Energy Agency, France

Biography

As Executive Director of the International Energy Agency, Dr Fatih Birol (@fbirol) has positioned the IEA at the forefront of global efforts to advance a secure, affordable and sustainable energy system. Since taking office in 2015, he has modernised the Agency by broadening its energy security mandate beyond oil to include electricity, natural gas, renewables and critical minerals, strengthened the Agency's global leadership in clean energy transitions and expanded IEA membership to include major emerging countries. As a result, the IEA's share of global energy demand coverage has increased from 40% to over 80%. He has also played a central role in the global response to major energy security emergencies, including those triggered by the invasion of Ukraine in 2022 and the 2026 Strait of Hormuz crisis.

Dr Birol joined the IEA in 1995 and steadily rose through the ranks from junior analyst to Chief Economist, where he oversaw the flagship World Energy Outlook. Throughout his career, he has been a leading advocate for expanding access to electricity and clean cooking solutions in developing countries, particularly in Africa.

He has twice been included in the TIME100 list of the world's most influential figures, in 2021 and 2026. His numerous honours include the French Legion of Honour, the Japanese Emperor's Order of the Rising Sun, the Swedish King's Order of the Polar Star, and the highest state decorations from Austria, Belgium, Germany, Italy, Korea, Portugal, and the United Arab Emirates.

Before joining the IEA, Dr Birol worked for the Organisation of the Petroleum Exporting Countries (OPEC) in Vienna. He holds degrees in power engineering and energy economics from the Technical University of Istanbul and the Technical University of Vienna. He also has an honorary doctorate from Imperial College London and has been elected a Foreign Member of the Chinese Academy of Engineering. He chairs the World Economic Forum's Energy Advisory Board and is an honorary life member of Galatasaray Football Club.

Challenges and Opportunities for The European Flat Glass Industry in The Sustainability and Energy Transition

Davide Cappellino

President AGC Architectural Glass Europe and Americas
Chairman of the Board, Glass for Europe, Belgium

Biography

Davide is from Cuneo, a town in Northern Italy surrounded by the Alps where AGC has a flat glass plant.

He studied nuclear engineering in Turin and joined the glass plant as engineer.

After a few years he was asked to join the European headquarters in Brussels, within the procurement department. Afterwards he was back as the Cuneo plant manager and country manager in Italy to then return to the European headquarters as strategy director. The next assignment was in Brazil, as CEO of AGC Vidros do Brasil, which involved the set up of the whole organization from scratch and developing the market in South America for both the automotive and construction segments. The next post was vice president for the business unit processed glass in Europe, followed by the function of regional president for the Americas for AGC Automotive in the United States.

Davide completed in these years an MBA at Solvay Business School and the Advanced Management Program at Harvard Business School.

Since 2022 he is President of the architectural glass business of AGC in Europe and the Americas and as senior executive officer also a member of the AGC Group's global executive committee.

Since March 2024 he is Chairman of the Board of Glass for Europe, the association of the European flat glass industry.

About AGC Glass

AGC Glass produces and sells primary float glass, transforming it into specialty and functional glass such as coated and laminated glass, fire resistant glass, mirrors and decorative glass. The firm also supplies processed glass to its customers, such as insulating glass panes for windows and façades. The float production sites are located in Belgium, France, Italy, Czech Republic, Spain, Germany and Brazil, completed by a wide network of processing and distribution units and commercial organizations in almost all the countries in Europe and South America.

Abstract

The flat glass industry is navigating an increasingly delicate balance between reducing CO_2 emissions and maintaining competitiveness. Decarbonization introduces significant technological challenges, requiring a shift away from well-established, highly optimized combustion-based processes. The primary alternative involves increasing the direct or indirect use of electricity, which raises both capital intensity and operating costs. At the same time, growing regulatory focus on energy efficiency of buildings, along with an emerging demand for low-carbon construction materials, is likely to create new market opportunities.

Will these opportunities offset the additional costs and risks?

Davide Cappellino will outline how AGC Glass Europe is preparing for this transition.

Keywords

decarbonization, electrification, CO_2 reduction, energy efficiency, low-carbon materials

Outside to Inside Inside to Outside

Murat Tabanlıoğlu

+MURAT TABANLIOĞLU Studio, Türkiye

Biography

Murat Tabanlıoğlu is the founder of +MURAT TABANLIOĞLU Studio, an international architecture, urbanism and design studio shaped by over 35 years of architectural experience, delivering cultural, hospitality and mixed-use projects, airports, stadiums and masterplans worldwide. Educated at the Technical University of Vienna, he leads a practice recognized for its culturally grounded, research-driven approach.

His work includes internationally acclaimed projects such as Atatürk Cultural Center, Tersane Istanbul, Istanbul Sapphire, Kanyon, Beyazıt State Library, Milas-Bodrum International Airport and Stade du Senegal. His work is defined by a strong dialogue between heritage and contemporary expression, creating timeless environments where culture, place and memory converge.

Alongside his professional practice, he is actively engaged in academia, international juries and global platforms, contributing to the discourse of architecture as both a cultural and civic act.

Abstract

As an architect, Istanbul, the city where I was born, raised, and continue to practice, has naturally been the primary source of inspiration and experimentation for my work. Over the past two decades, I have had the opportunity to design projects not only in Istanbul and across Türkiye, but also throughout Europe, Africa, Asia, and the Americas. Each project carries its own story, shaped by its location, culture, users, and purpose. Many of these projects have become some of the most actively used and recognizable places within their cities, including media centers, airports, hotels, offices, residential developments, and mixed-use destinations.

Glass, the focus of this presentation, is often the most critical layer of a building. As the building envelope, it mediates the relationship between exterior and interior, creating a continuous dialogue between outside and inside. Throughout the design process, I repeatedly explore this relationship through sketches, questioning how architecture can respond both from the outside in and from the inside out.

One of the most significant examples of this approach was the renewal of the Atatürk Cultural Center in Istanbul. Originally designed in the 1960s by my father, Hayati Tabanlıoğlu, the building was reinterpreted with the intention of preserving its memory while bringing it into the present. The iconic transparent glass façade and aluminum screen were recreated using contemporary technologies, maintaining the spirit of the original design while enhancing its performance.

In other projects, glass has been used to create secondary building skins, introducing additional layers through color, texture, transparency, and reflection. These interventions contribute not only to environmental performance but also to the architectural identity of the building.

Much like aviation and Formula 1 technologies, glass continues to evolve at an extraordinary pace. It is one of the most advanced and transformative materials available to architects today. Yet its successful application requires careful consideration, collaboration with skilled engineers, and a deep understanding of context, performance, and human experience. The projects presented demonstrate that glass is far more than a construction material. It is a design tool capable of shaping the relationship between architecture, people, and place. Ultimately, its greatest value lies in its ability to create a seamless dialogue between outside and inside, redefining how we experience buildings and the cities around them.

Keywords

glass architecture, façade design, building envelope, transparency, inside-outside relationship

40th ŞİŞECAM INTERNATIONAL GLASS CONFERENCE

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PANELISTS

18-19 JUNE 2026 İSTANBUL

Gianpiero Nacci

Managing Director, European Bank for Reconstruction and Development (EBRD).

Gianpiero Nacci is the Managing Director of the Climate Strategy and Delivery (CSD) Department at the European Bank for Reconstruction and Development (EBRD). He was appointed to this position in January 2025.

Mr. Nacci leads a team of green finance specialists, economists, policy experts and engineers who drive the EBRD's green financing, technical assistance, and policy engagements across all sectors of the economy. Mr. Nacci is also responsible for driving the development and implementation of approaches that maximize the EBRD's green impact, particularly by leveraging private mobilization to deliver green finance at scale and ensuring that the EBRD's activities are aligned with the objectives of the Paris Agreement.

Before his appointment, Mr. Nacci was the Director of the Sustainable Business and Infrastructure team in the Climate Strategy and Delivery Department at the EBRD, where he was responsible for the Bank's green activities in the corporate, energy, and infrastructure sectors. He was also responsible for coordinating the EBRD's work on climate resilience, just transition, and nature finance.

Mr. Nacci has over 25 years' experience in climate policies, sustainable manufacturing, circular economy, and clean energy, with a particular focus on emerging markets.

An Italian national, he holds an MSc in Mechanical Engineering from Politecnico di Torino (Italy) and an MSc in Renewable Energy from the University of Oldenburg (Germany).

Erik Muijsenberg

Business Development Director, Glass Service Group, Czechia
President, International Commission on Glass (ICG)

Erik Muijsenberg is a Mechanical Engineering graduate from Eindhoven University (1990) with a long-standing career in the glass industry. He began at TNO Glass, specializing in furnace modeling and glass melt technology, and became Department Leader in 1997.

In 1998, he became Managing Director of GLASS SERVICE B.V., establishing its first subsidiary in the Netherlands. After 11 years, he moved to the company's headquarters in the Czech Republic, serving as Group Vice President. Glass Service has a global presence with over 120 engineers and includes key subsidiaries such as FlammaTec (combustion systems) and FIC UK (electric melting solutions).

In April 2024, Glass Service Group joined SEFPRO, and Muijsenberg was appointed Group Business Development Director. In April 2026, he was elected President of the International Commission on Glass (ICG).

He has been a strong advocate for Industry 4.0, focusing on advanced furnace control and reducing carbon emissions in the glass industry for more than 20 years.

Awards: Otto Schott Award (1998), German Dietzel Award (2012), SGT UK Fellow (2014), ICG Turner Award (2023), N.L. Varshneya Memorial Award (2023), and Flogen von Klitzing Award (2023).

Additional Roles:

Chair/Vice Chair of ICG TC21 (2010–2024)

ICG Vice President (2024–2026)

ICG President (2026–)

Chairman of Phoenix Glass Person of the Year (2024)

Dr. Dominik Orzol

Managing Director
International Partners in Glass Research (IPGR) e. V., Germany

Dominik Orzol leads IPGR, a global research alliance of glass manufacturers focused on innovation and future-ready technologies for container glass.

With a background in material science, he plays a key role in coordinating research, enabling cross-industry collaboration, and advancing solutions for decarbonization and digitalization.

Justin Kelly

CEO, Glass Futures, United Kingdom

Justin is a Chartered Engineer with a BEng (Hons) in Computers, Management and Electronics. He began his career at Siemens where he held several roles over nearly three decades culminating in his appointment to the Siemens Executive Management Board in 2017.

Committed to driving innovation, Justin was the founding CEO of the Sustainable Materials and Manufacturing Centre in Greater Manchester to benefit both the economy and environment. In 2023 he became Non-Exec Chair of Sustainable Ventures North, an organisation dedicated to supporting sustainability-focused start-ups across the country.

Justin has overseen significant progress at Glass Futures since joining as CEO in November 2024, including the recent completion of the first campaign of alternative fuel trial programmes.

Oscar Verheijen

CelSian Glass & Solar BV, Netherlands

In 1995, Oscar Verheijen received his master's degree in chemical engineering at the Eindhoven University of Technology in the Netherlands. Following this, he started as a glass technologist at the Dutch research institute TNO. In 2003, Oscar finalized his Ph.D. study entitled 'Thermal and chemical behavior of glass-forming batches'. After being active for 12 years in the field of glass melting technology, glass tank modeling, and process control, Oscar became responsible for the business development of sustainable technologies with an emphasis on thin-film solar technologies. In September 2013, Oscar joined CelSian. Currently, Oscar is the Commercial Director of CelSian and Chairman of GlassTrend, the global platform of pre-competitive R&D and knowledge exchange. Oscar's key activities are dedicated to smart, sustainable glass manufacturing.

Burak Arık

CEO, Maxitech, US
General Partner, Maxitech Ventures

Maxitech operates at the intersection of enterprises and startups, bridging two worlds that need each other but rarely speak the same language. As the Silicon Valley subsidiary of İşbank, Türkiye's largest private bank, the company is led by Burak Arık, who works at the forefront of technological innovation. He observes emerging trends firsthand, distinguishes real capability from hype, and connects enterprises with technologies and startups that create tangible business value.

Through Maxitech Ventures, Arık invests in enterprise and AI startups, while also collaborating closely with large organizations on innovation strategy, high-impact use cases, and partnerships with leading founders. He is also a frequent TV guest, sharing insights on artificial intelligence and its implications for enterprises.

Arık relocated to Silicon Valley a decade ago upon his appointment as CEO of Maxitech. Prior to that, he served as an engineering manager in Istanbul. He holds a master's degree in computer engineering and earned his MBA from Wharton in 2025, strengthening his technical foundation with deep expertise in business, finance, and leadership. Despite his executive role, he maintains a strong interest in how technology is built and continues to write code in his personal time.

Dr. Sabri Alamri

Fusion Bionic GmbH, Germany

Sabri Alamri is a materials scientist and mechanical engineer creating functional surfaces with laser-based micro- and nano-textures. His work focuses on precision micromachining technologies, particularly Direct Laser Interference Patterning (DLIP), to tailor surface properties across metals and glass.

In the last years, his research emphasizes advanced glass processing and finishing, enabling functionalities such as anti-glare, anti-soiling, and controlled optical behavior through bioinspired microstructures—without relying on coatings.

Following his PhD, he co-founded in 2021 Fusion Bionic to industrialize scalable laser-based surface treatments for applications in optics, semiconductors, and advanced materials.

Nicolas Fedullo

VP Innovation, Technology and New Business
AGC Glass Europe, Belgium

Nicolas Fedullo is a Material Sciences Engineer (UCLouvain, 2000).

He joined AGC Glass Europe (former Glaverbel) in 2005, incorporating R&D in the Glass Fusion and Refractory department. Between 2010 and 2012, he moved to Italy as production manager of a flat glass (float) production line.

He came back to headquarters to take over the Float Industrial Excellence team until 2017. He was then appointed as Manufacturing Director Europe of the Upstream Operation. (Float, Laminated, Mirror, Coating, Acid Etched and Automotive primary glass). During his appointment, he realized various cost reduction program, cold repair management and strategy and initiate an important shift in the operations from cost to service.

Since April 2022, he has joined the European Executive board of AGC Glass Europe as Vice-President "Technology, Innovation and New Business" of AGC Glass Europe, managing the innovative activities of the group in Europe from the AGC Technovation Centre. His mission focuses on providing meaningful industrial way to reduce greenhouse gas emissions, develop new process for new products and streamline the new activities at the border of AGC core business.

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Data-Driven High-Throughput Experimentation for Materials Discovery

Lars Banko

XEMX Materials Space Exploration GmbH, Germany

Abstract

Data-driven high-throughput experimentation is transforming how materials are discovered, optimized, and translated into scalable technologies. This talk presents an integrated approach that bridges advanced experimentation with real-world impact using physical vapor deposition (PVD) coating technology as a central platform.

At the core are highly adaptive synthesis machines combined with automated measurement systems, enabling rapid generation of large, application-relevant materials datasets. By tightly integrating artificial intelligence and machine learning directly into experimental hardware, software, and workflows, experimentation becomes guided by real-time data analysis, adaptive data acquisition, and closed-loop optimization.

This methodology delivers value through faster material development in two key ways: (1) creation of custom experimental datasets to efficiently explore material parameter spaces and identify optimal compositions, and (2) accelerated material prototyping to enable early application testing under realistic conditions.

The approach is illustrated through use cases including optical coatings and electrochemical catalysts for green energy applications, demonstrating how data-driven experimentation accelerates the path from discovery to deployment.

Keywords

high throughput experimentation, materials discovery, functional coatings

Broad Beam Plasma Source Enhanced Thin-Film Growth

Qi Hua Fan[1], David Stevenson[2]

[1]Michigan State University, US
[2]Ampres, Inc., US

Abstract

Effectively modulating microstructure is critical to controlling thin-film properties. Achieving a specific phase typically requires thermodynamic equilibrium conditions. However, many coatings involve heat-sensitive materials or have thermal budget limitations. This talk introduces a newly developed broad beam plasma source that enhances magnetron discharge and thin-film growth. The beam plasma source performs two essential functions. First, it delivers a single beam of ions with independently controllable energy and flux density, enabling effective energy transfer to the growing film at the atomic scale. Second, it reduces the magnetron discharge voltage by more than 40% due to the increased plasma density. Together, controlled ion impacts and the suppression of the high-energy tail of sputtered atoms promote film densification. By tuning the ion energy in the range of 10-150 eV, polycrystalline thin films can be grown at temperatures far below the phase equilibrium conditions. Using beam-plasma-source-enhanced sputtering, a variety of thin films with dense morphologies and significantly reduced surface roughness have been produced, demonstrating the unique advantages of this new growth paradigm. Application examples include ultra-thin silver films (<7 nm) for low-E coatings, (0002) oriented AlN piezoelectric thin films grown at room temperature, Meta Mode deposition of high-refractive-index Nb_2O_5 thin films, and high-rate deposition of SiO_2 thin films. The broad beam plasma source can be scaled to any length for large-area coating applications.

Keywords

thin film, plasma-assisted deposition, low-e coating

In Silico Optimization of Low-E Coatings with Reduced Silver Consumption: From Atomic to Industrial Scale

Jérome Müller[1], Abdel Ghafour El Hachimi[2], Pavel Moskovkin[1], Stéphane Lucas[1], Valentin Lucas[1]

[1] Innovative Coating Solutions, Belgium
[2] University of Namur, Belgium

Abstract

Functional glass technologies play a central role in applications from photovoltaics to energy-efficient architectural glazing. Among these, low-emissivity (Low-E) glass has gained significant attention due to its ability to reduce energy consumption by reflecting infrared radiation while maintaining high visible light transmittance and neutral color. However, conventional Low-E coatings rely heavily on silver layers, a critical raw material (CRM), making the reduction of silver usage a key technological and economic challenge.

In this work, we investigate dielectric–metal multilayer thin films deposited by magnetron sputtering using physical vapor deposition (PVD). These coatings typically consist of alternating silver and oxide/nitride layers (e.g., TiO_2, ZnO, AZO). The composition, density, and thickness of each layer are strongly influenced by process parameters, which in turn affect film uniformity and optical performance.

The objective of this study is to minimize silver consumption while preserving or enhancing optical properties. To achieve this, a multi-objective genetic algorithm ConstelCoat™ is coupled with a film growth simulation software Virtual Coater™, enabling simultaneous optimization of layer architecture and deposition conditions. The modeling framework spans multiple scales, from three-dimensional industrial coater configurations down to atomic-scale film growth using a kinetic Monte Carlo approach, allowing prediction of key material properties such as composition, density, and effective refractive indices.

Particular attention is given to the impact of coater design and critical deposition parameters (e.g., power, pressure) on both silver layer efficiency and overall coating performance. This integrated approach provides a pathway to design Low-E coatings with reduced reliance on silver, contributing to more sustainable and resource-efficient glazing technologies.

Keywords

low-e glass coatings, magnetron sputtering, multi-objective optimization, digital twin simulation

High Entropy Alloy Thin Films as Multifunctional Coatings for Glass: Synthesis, Microstructure, and Surface Properties

Uğur Ünal

Koç University, Türkiye

Abstract

High entropy alloys (HEAs), defined as alloys containing five or more principal elements in equal or near-equal atomic percentages have gained remarkable attention over the past two decades owing to their excellent mechanical and tribological properties. Their distinctive behavior arises from four core effects: the high entropy effect, severe lattice distortion, sluggish diffusion, and the cocktail effect, which collectively yield property combinations unattainable in conventional alloys. High-entropy alloys (HEAs) and related high-entropy nitrides/oxides offer a versatile materials platform for next-generation functional coatings. Unlike conventional alloy coatings, HEAs use multiple principal elements to generate chemically complex solid-solution, amorphous, or nanocrystalline structures with tunable hardness, corrosion resistance, oxidation stability, wear resistance, hydrophobicity, and thermal durability. Recent studies show that magnetron sputtering is especially suitable for producing dense HEA thin films, while reactive sputtering enables nitride and oxide derivatives with enhanced mechanical and chemical stability. These properties are highly relevant for glass surfaces exposed to abrasion, humidity, thermal cycling, and chemically aggressive environments. In thin-film form, HEA films tend to form solid solution and amorphous states with hardness far exceeding that of traditional films. For example, DC-sputtered $Ti_{1.5}ZrTa_{0.5}Nb_{0.5}Hf_{0.5}$ HEA coatings have demonstrated dense, uniform structures with strong substrate adhesion and hardness superior to the underlying material, alongside corrosion rates as low as 0.50×10^{-3} mm/year in saline solution. In this presentation, I will review synthesis, structure, property relationships in HEA coatings, with emphasis on sputtered metallic, nitride, and oxide films, and discuss their potential integration with glass for protective, durable, and multifunctional surfaces. By connecting HEA design principles with scalable coating technologies, this work highlights a promising route toward advanced glass products for energy, architectural, automotive, and specialty applications.

Keywords

high entropy materials, coatings, corrosion, energy conversion

Challenges & Developments for Glass Protection

Charly Hoebers

R&D Department, Nitto Belgium NV, Belgium

Abstract

Low emissivity (low e) coated glass delivers significant benefits in relation to energy efficiency but is highly sensitive to mechanical damages and corrosion. This particularly applies to soft coats which are susceptible to moisture induced degradation of their functional layers (usually silver).

During handling, transport, storage, and downstream processing, insufficient protection can lead to mechanical damages, corrosion, yield loss, and increased operational costs. To address these challenges, a temporary protection film has been developed, consisting of a polyethylene backing combined with a carefully engineered pressure sensitive adhesive layer.

This solution provides effective protection against mechanical damages such as scratches and punctures, while also acting as a moisture barrier (humidity, fingerprints) to prevent corrosion of the low e coating. Adhesion levels can be precisely tailored to the specific substrate, enabling reliable performance on a wide range of coating stacks, including solutions designed for non tempered glass. The tape maintains stable adhesion without lifting or delaminating during critical insulated glass unit (IGU) manufacturing steps, including edge deletion, edge grinding, washing, and internal handling, thereby ensuring continuous surface protection throughout the whole process chain.

Despite its robust protective performance, the tape can be removed easily and cleanly immediately prior to tempering, leaving no adhesive residue and eliminating the need for re cleaning. In parallel, development efforts are underway to introduce a low outgassing variant suitable for protecting glass surfaces that pass directly through PVD coating processes, expanding the applicability of the solution upstream in glass manufacturing.

Uniquely, this protective solution is available in widths up to 3.3 meters, enabling full width protection of jumbo glass sizes without overlaps or seams. All tape constructions are designed with recyclability in mind, supporting sustainability objectives across the glass value chain. By combining tailored adhesion, large scale availability, broad process compatibility, recyclability, and protection against both mechanical and environmental damage, this solution enables improved product quality, reduced scrap rates, and enhanced operational efficiency for glass producers and IGU manufacturers.

Keywords

low-e, corrosion, temporary protective film

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Application and Potential of Microwave Heating for Energy Efficient Glass Technology

Erik Muijsenberg

Business Development Director, Glass Service Group, CZ Czechia
President, International Commission on Glass (ICG)

Abstract

The European Union has established stringent targets for CO_2 emissions over the next 30 years. By 2030, emissions must be reduced by 55% compared to 1990 levels, with the ultimate goal of achieving climate neutrality by 2050. It is evident that these ambitious targets cannot be achieved using current furnace designs.

The International Commission on Glass (ICG) has a pivotal role in fostering collaboration and knowledge exchange across regions by organizing conferences focused on sustainability.

To achieve meaningful reductions in carbon emissions, innovative furnace designs and new technologies must be developed. Such advancements require the use of validated Computational Fluid Dynamics (CFD) tools like the GS Glass Furnace Model (GS GFM). No glass producer would risk building a new furnace concept capable of melting over 100 tons per day without rigorous analysis, calculations, and CFD modeling. Recent trends show increasing interest in reducing carbon emissions through greater reliance on electric melting or hydrogen, similar to the widespread adoption of CFD modeling during the rise of oxy-fuel technologies. Now, with the next generation of large hybrid furnaces (with over 50% electric boosting) or fully electric melters.

These complex furnaces, with multiple heat inputs, also require advanced control systems, such as Model-Based Predictive Control, to optimize the balance between electricity and natural gas usage. This approach considers fluctuating costs and aims to maximize carbon reduction.

This presentation will address the following key topics:

- Introduction: The role of the ICG and the significance of glass in modern applications – the Glass Age.
- Renewable Resources: The importance of clean electricity for reducing carbon emissions and updates on global developments in renewable energy.
- History of Electric Melting: A brief overview of the evolution of electric glass melting technologies.
- Segment-Specific Technologies: Exploration of the most viable decarbonization technologies for various segments, such as crystal and tableware, container glass, borosilicate, fiberglass, and flat glass.
- Case Studies: Examples of large-scale all-electric and hybrid melters currently in operation, with a focus on the performance of a large hybrid melter.
- Forehearth Electrification: Insights into the potential for 70–90% energy and carbon emission reductions through electrifying forehearths.

Keywords

ICG, IYOG, hybrid furnace, electric boosting, all-electric melting, decarbonization, CO_2 reduction, furnace design, forehearth design, energy audit, modeling, renewable energy

LionGlass: from Research to Industrial Assessment of Low-Carbon Glass Compositions

Elisa Biavardi[1], Andrea Marostica[1], Andrea Varacca[1], A. Caruso[1], Nicholas Clark[2], John C. Mauro[2]

[1] Bormioli Luigi Group, Italy;
[2] The Pennsylvania State University, US

Abstract

Glass industry is one of the most energy-intensive manufacturing sector and is responsible for significant CO_2 emissions, mainly because of the high melting temperatures required and the use of carbonate-based raw materials. In this context, the development of low-carbon glass compositions offers a promising route to reduce the environmental impact of glass production.

This work focuses on LionGlass, a new family of glass compositions developed as an alternative to conventional soda-lime silicate glass. The study aims to assess its potential for industrial application, particularly in the production of high-quality glass, through a compositional redesign that eliminates carbon-containing batch materials and significantly lowers the melting temperature.

Developed by Penn State University, LionGlass is based on carbonate-free formulations that reduce CO_2 emissions at the source. In addition, the melting temperature can be lowered by approximately 300–400°C, enabling a substantial reduction in energy consumption and further decreasing CO_2 emissions associated with glass manufacturing.

Within this framework, Bormioli Luigi Group is involved as an industrial partner in collaboration with Penn State. Current activities focus on identifying, within the LionGlass family, the compositions best suited to industrial processing, with particular attention to processability and compatibility with existing production technologies, and final product quality. These efforts are intended to support the scale-up from laboratory research to industrial application.

The ongoing work demonstrates the potential of LionGlass as a breakthrough solution for reducing the carbon footprint of glass manufacturing. The final objective is to achieve industrial implementation and commercialization, with a specific focus on the premium beauty market.

Keywords

CO_2 emissions reduction, carbonate-free compositions

Performance of High-Purity $MgO–Al_2O_3$ Spinel Refractories under Alkali-Rich and High-Humidity Conditions in Modern Glass Furnaces

Daniela Messina, Markus Dietrich

RHI Magnesita, Italy

Abstract

The transition toward hybrid furnace concepts, oxy-fuel combustion, and hydrogen-enriched firing is significantly altering the thermochemical conditions in glass furnaces. These changes result in lower crown temperatures combined with increased water vapor and alkali activity, accelerating corrosion and degradation of conventional silica and fused-cast AZS refractories, particularly in crown and superstructure areas.

To address these challenges, this study evaluates the performance of a high-purity magnesia–alumina spinel ($MgAl_2O_4$) refractory based on an equimolar $MgO–Al_2O_3$ composition. The material is characterized by a homogeneous crystalline microstructure, high phase stability, and low chemical reactivity in sodium-rich environments. Its high melting point (~2135°C) provides a strong basis for high-temperature applications.

Thermomechanical performance was assessed through refractoriness-under-load (RUL) and creep testing. The material exhibits RUL values above 1800°C and stable deformation behavior under sustained load at 1650°C over extended durations. Corrosion resistance was investigated using alkali vapor exposure tests, demonstrating significantly reduced sodium penetration and degradation compared to conventional refractory systems. Additionally, the spinel composition shows resistance to boron-containing atmospheres, supporting its applicability in borosilicate glass environments.

These results indicate that high-purity $MgO–Al_2O_3$ spinel refractories are a promising solution for demanding applications in glass furnace crowns and superstructures. Their use can contribute to extended furnace campaign lifetime, improved resistance to aggressive atmospheres, and enhanced operational reliability in next-generation glass melting technologies.

Keywords

$MgO–Al_2O_3$ spinel, glass furnace, alkali corrosion, oxy-fuel, hydrogen firing

Next Generation Glass with Glass Futures: Building a Digital Furnace

Aston Fuller

Glass Futures, UK

Abstract

Glass Futures is a not-for-profit research organisation, built by its members from across the global glass industry with the overarching goal of decarbonisation of the glass-making process and its upstream and downstream activities. Based out of the Glass Futures Centre of Excellence in St Helens, UK: the remit of the organisation is to enable its members from across the glass supply chain and beyond to collaborate in areas which affect all parties. A key shift in focus of the business has been towards digitization of its assets to enable members to run digital experiments that yield real results.

At the heart of the Glass Futures Centre of Excellence is a 30 tonnes/day pilot-scale glass furnace, capable of producing either flat or formed-glass. The facility has been designed to enable the glass industry to develop and trial new technologies at an industrially relevant scale, without risk to their commercial manufacturing assets. The facility is controlled through a single, central control system that allows complete oversight and control of the facility from one location.

In this paper, the challenges and triumphs of building a digital furnace and full-plant digital twin will be discussed. The journey of classifying, deploying and developing various artificial intelligence and machine learning technologies to allow for greater insights into a fully connected glass plant will be explained. Finally, the steps taken to develop and validate bespoke furnace models that have allowed the physical furnace to be brought into the digital age – allowing experimentation without emissions – will be highlighted.

Keywords

digitization, decarbonization, simulation, artificial intelligence, digital twin

Development of a Fused Cast AZS Refractory with High Electrical Resistance for Glass Furnaces

Roland P. Heidrich

REFEL S.p.A., Italy

Abstract

Refractories used in the construction of glass melting furnaces are critical components that determine the operational life of the furnace and the quality of the produced glass. Fused cast AZS (Alumina-Zirconia-Silica) refractory is widely preferred in glass furnaces as they provide high corrosion resistance and structural integrity. These refractories typically consist of a glassy phase that fills the interstitial spaces of the crystalline phases corundum and zirconia. Therefore, fused cast AZS products are free of open porosity in contrast to standard sintered refractories; and thus superior to the latter in application characteristics.

In the technical literature and current applications, it is recognized that in traditional fused cast AZS blocks the alkali metal oxides lower the viscosity of the glassy phase, which can cause undesirable reactions with the glass melt inside the furnace (premature corrosion) or exudation (glass defects).

This is especially true at higher temperatures when transmitting electrical energy via melting electrodes directly into the glass melt —instead of fossil fuels— to avoid carbon emissions for environmental reasons. With the planned increase in the use of green electrical energy, the AZS blocks that are in direct contact with the electrodes must therefore meet very special requirements.

The extensive electrification requires a fused cast AZS refractory for electrode blocks exhibiting high electrical resistance compared to molten glass; it ensures that they withstand the high-temperature values originating from electrode heating and that electrical short circuits, resulting in premature refractory failure and furnace damages, are prevented. Therefore, objective is the development of an alkali-free glassy phase for fused cast AZS electrode blocks.

Keywords

refractory, electrode blocks, electric melting

DESIGN

The Ambition of Glass: Elevating Packaging, Brands and Experiences

Andrea Ucchino

Studio One Eleven, Berlin Packaging, Italy

Abstract

Glass has always played a strategic role in packaging, combining protection, transparency, safety and perceived value. This paper explores glass not only as a technical material, but as a powerful medium capable of elevating products, brands and consumer experiences.

From the perspective of Berlin Packaging, a Hybrid Packaging Supplier operating across food, beverages, beauty, personal care, healthcare and industrial markets, the work focuses on what happens after glass leaves the furnace: how it becomes part of a complete packaging system, integrating design, decoration, closures, supply chain, sustainability and market expectations.

The purpose of the paper is to demonstrate how glass can move beyond its function as a container and become a presence: an object that lives in homes, retail spaces and daily rituals, contributing to atmosphere, desirability and brand storytelling. In this sense, glass can be considered one of the most ambitious materials in packaging, able to set standards and increase the value of everything it touches.

The approach combines market observation, design thinking and selected packaging examples developed by Berlin Packaging, with particular attention to premiumization, refill models, cross-market inspiration and the evolution of glass into lifestyle-oriented objects.

The innovation of the work lies in connecting the industrial and technical value of glass with its emotional, cultural and experiential dimension. The relevance to the conference topic is linked to the future transformation of glass: not only through energy, technology and production, but also through its ability to remain desirable, sustainable and meaningful for brands and consumers.

The paper concludes that the future of glass packaging will depend on collaboration across the value chain and on the ability to design solutions that are lighter, smarter, more responsible and more connected to contemporary life.

Keywords

glass packaging, brand experience, sustainability, design innovation, premiumization

At the Frontier of Manufacturing the Rise of AI-Powered Frontier Firms

Cüneyt Batmaz

Microsoft, Türkiye

Abstract

Artificial intelligence has evolved from a supporting tool into a strategic layer that is rebuilding the entire value chain of the manufacturing sector — from ideation and visualization to similarity analysis, IP and registration monitoring, portfolio management, new product development, production line optimization, and quality control. The emerging concept of the "Frontier Firm" describes organizations that bring together human expertise, generative AI, and autonomous agents within a shared operating model — and industrial production and design sit at the very center of this transformation.

This session explores, through the lens of the strategic partnership with NVIDIA, how generative and multimodal AI deliver step-change gains in speed, quality, discovery, and scalability for production and design teams. In the context of glass houseware and industrial manufacturing, it examines concrete scenarios such as similarity search, IP and registration monitoring, detection of equivalent products in the market, portfolio enrichment, photorealistic rendering, and digital-twin-based simulation of production processes — discussed from the perspective of integrating with existing workflows.

At the heart of the approach is positioning AI not as a replacement for human expertise, but as a collaborative intelligence that strengthens people, accelerates their intuition, and scales both their creative and operational output. The session also offers practical guidance on data privacy, IP and copyright sensitivity, model governance, and the business–IT operating model, equipping participants with a clear perspective on the journey to becoming a "frontier firm" in the global glass and manufacturing industry.

Keywords

artificial intelligence; generative artificial intelligence; industrial design; glass design; similarity search; PLM; microsoft; secure innovation

Shaping the Physical Identity of a Global Beer Icon

Janwillem Bouwknegt

NPK Design, Netherlands

Abstract

Janwillem Bouwknegt will introduce the latest addition to Heineken's global glassware portfolio: the Star Mark glass range. Developed as a new and highly visible brand touchpoint, this range is designed to reach millions of consumers in bars and hospitality venues worldwide. The presentation will outline the strategic thinking behind the design, showing how a single, distinctive element can strengthen recognition and elevate the drinking experience while remaining fully aligned with Heineken's established brand identity.

Building on a long-standing collaboration in which npk design has developed a wide variety of Heineken glass products, the Star Mark range fits within a broader, coherent brand world. Janwillem will explain how this cumulative body of work has contributed to a tangible design DNA—one that ensures consistency across different contexts, markets, and product typologies, while still allowing room for innovation.

He will also share insights into the design and development process, from translating brand values into physical form to navigating the realities of large-scale glass production. Particular attention will be given to how design decisions perform at scale, both visually and technically, and how precision in execution is essential when creating objects that represent a global icon in everyday use.

Keywords

pushing boundaries for perfection

Branding and Packaging Design Trends

Orhan Irmak

Orhan Irmak Tasarım, Türkiye

Abstract

Assuming that a package designed today will remain on the shelf for the next 3 to 5 years, each packaging design actually embodies a vision of the future. In terms of brand strategies, this period can be considered much longer. Therefore, in the world of branding and packaging design, trends must always be carefully monitored. In his talk titled "Branding and Packaging Design Trends," Dr. Orhan Irmak compiles pioneering approaches and designs, offering a future perspective.

Examples for branding and packaging design work are examined under the following 8 headings: Regenerative sustainability, AI-Driven Packaging Ecosystems, The Human Side of Design, Must Be Inclusive, Contributing to the Community, From Big Brands to My Brands, Cultural Connections Redesigned, and Storytelling.

Keywords

trends, packaging, design, branding

AI and Creativity … Is the Glass Half Empty or Half Full

Sebastian Schwartze

BSH Home Appliances Group, Germany

Abstract

Creativity, authenticity, and consistency play a decisive role in design and marketing. What contribution can Artificial Intelligence already make today, and what role will we as designers and marketers play in the future? How do I control an AI to get the exact results I am looking for? Will AI become more creative than we could ever be, or does the future lie in hybrid working models with AI? A 360° experience.

Keywords

AI, creativity, future, design, marketing

Automotive Glazing Advanced Products and Advanced Production Technologies

Luigi Stigliano

Independent Plant Engineering Specialist -
Automotive Glass Production, Italy

Abstract

The automotive glazing industry faces growing demand for complex, high-performance glass products — coated panoramic roofs, HUD-compatible windscreens, low-angle backlights — that push conventional production technologies to their limits. This paper presents an integrated framework of advanced manufacturing solutions developed to address these challenges, with emphasis on both new plant design and the upgrading of existing production lines, including furnace systems and press bending equipment.

Two bending furnace technologies are examined in depth. The Indexing Bending Furnace (IBF), a sag-based internal press bending system equipped with selective convection heating, is shown to be the optimal solution for coated top roof glass at moderate production volumes, achieving 27–50 pcs/h with full CFD-validated thermal control. The Advanced Glass Shaping (AGS) line, based on external press bending, represents the high-volume reference: operating at up to 400 pcs/h in double-row configuration, it enables simultaneous forming of Ag3-coated outer and LowE-coated inner plies with 60-minute changeover and surface deviation within ±0.1 mm. A structured comparison of the two technologies provides a decision framework based on product complexity, volume, and optical quality requirements. Existing lines can be significantly upgraded — through new heating systems with convection, new press stations, shuttle systems, improved quench equipment, and frontal tool changeover systems — without full replacement.

The paper further addresses advanced auxiliary equipment: a Variable Radius Roll Bender (N20) capable of continuous radius adjustment from flat to 1100 mm — replacing up to ten fixed bending units — and an Advanced Nip Roll laminator with automatic radius set-up and robot-assisted feeding. Both systems are presented as upgrade options for existing tempering and laminating lines.

Simulation-driven development, including FEM bending feasibility, mold compensation, optical distortion prediction, and CFD furnace modelling, is discussed as the enabling methodology for right-first-time tooling and faster industrialization.

Keywords

automotive glazing; external press bending; coated glass; bending simulation; plant upgrading

DIGITAL & ARTIFICIAL INTELLIGENCE

AI-Driven Optimization of Glass Production

Oscar Verheijen, Johan van der Dennen

CelSian Glass & Solar BV, Netherlands

Abstract

The authors should address the conference topic, provide the full title, full name and contact details for corresponding author(s), affiliation, phone, e-mail, purpose of the work, approach, scientific innovation and relevance, quite brief insight about the results and conclusions.

The glass industry operates in an increasingly complex environment, with rising demands for quality, energy efficiency, and cost optimization. Furnace operators play a critical role in navigating these challenges, yet they face an overwhelming volume of process variables and data points to analyze in real-time. This raises the following question: How can we provide operators with actionable insights, reducing guesswork and improving confidence?

Traditionally, furnace control systems have focused on stabilizing temperatures, yet temperature stability alone does not guarantee optimal glass quality. Aligning operational performance, reliability, and glass quality requires a deep understanding of the dynamic, time-transient behavior of glass furnaces. The challenge lies in the broad residence time distribution, influenced by multiple variables, and the difficulty of identifying key process parameters that impact glass quality. Moreover, conventional systems struggle to adapt to sensor deterioration or replacement, leading to data inconsistencies and reduced reliability.

This presentation introduces Celfos, an AI-powered system that enhances operational decision-making by linking process settings to glass quality. By combining advanced neural network models with time-transient CFD analysis (GTM-X), Celfos provides insights into complex furnace dynamics and delivers precise quality predictions.

Celfos combines historical furnace data and real-time process parameters with qualitative GTM-X models. It works for all common glass and furnace types and is control system independent. The neural network is trained to correlate these inputs with glass quality metrics, enabling predictive quality control and adaptive decision-making, even when sensors degrade or are replaced.

Celfos is a dynamic, adaptive system that brings the glass industry closer to a future of precision and efficiency, designed to support operator expertise.

Keywords

artificial intelligence, quality control, cost optimization, CFD

Accelerating the Future of Glass Manufacturing with AI

Hervé Dumas

Google Cloud Middle East, North Africa and Turkey

Abstract

The glass manufacturing industry faces unprecedented disruptive pressures, including volatile energy costs, costly unplanned downtime, and a widening skills gap. To navigate these headwinds and achieve next-level performance, manufacturers are increasingly piloting Artificial Intelligence (AI) and Generative AI initiatives. However, realizing the full potential of these technologies is often hindered by a critical data challenge: the disconnect between operational technology (OT) on the shop floor and enterprise IT systems. This fragmentation creates a “data wall” that blocks the transition from ambition to scaled reality.

This presentation introduces a strategic blueprint for overcoming these silos by building a unified data foundation. By leveraging a centralized manufacturing data engine, glass producers can establish seamless, secure connectivity from edge sensors and furnaces directly to the enterprise cloud. This universal data context is the prerequisite for deploying advanced, multimodal AI systems capable of reasoning across diverse data streams simultaneously.

For glass production, this unified approach enables AI to analyze thermal logs for furnace optimization, evaluate material consistency, and utilize visual imagery for automated defect detection. Drawing on successful real-world deployments, this session will demonstrate how bridging the IT/OT divide empowers plant operators to transition from reactive monitoring to proactive systems of action that drive efficiency, increase asset utilization, and boost profitability.

Keywords

artificial intelligence, data unification, smart manufacturing, multimodal ai, process optimization

End-to-End Digitalization as a Key Enabler for Sustainable and Efficient Glass Manufacturing

Magdi El-Awdan

Siemens AG, Germany

Abstract

In an increasingly demanding and competitive environment, the glass industry is under strong pressure to improve energy efficiency, reduce emissions, ensure consistent product quality, and increase operational flexibility. Traditional plant operation and isolated optimization efforts are no longer sufficient to address these challenges holistically across the entire value chain.

This contribution presents how end-to-end digitalization, powered by Siemens Digital Industries, enables seamless integration of glassmaking processes—from raw material handling and melting through forming, inspection, and lifecycle management. By combining industrial automation, advanced planning and scheduling, simulation, digital twins, Industrial IoT, and data-driven analytics, glass manufacturers can transition from reactive plant operation to proactive and predictive decision-making.

Siemens' comprehensive digital portfolio transforms production data into business-relevant decision support, providing real-time transparency across all production stages. Predictive maintenance, simulation-based optimization, and advanced analytics help stabilize processes, increase yield, reduce downtime, and improve energy and resource efficiency.

Beyond operational excellence, end-to-end digitalization plays a key role in supporting sustainability goals. Plant-wide transparency, energy monitoring and the integration of technologies such as waste heat recovery, cullet optimization, and low-carbon solutions via partners enable measurable reductions in emissions while maintaining high product quality. The result is a future-ready glass plant that combines productivity, sustainability, and resilience—driven by Siemens' end-to-end digitalization expertise.

Keywords

digitalization, simulation, integration, transparency, productivity

System Intelligence Through Collaboration

Paul Schreuders

XPAR Vision, Netherlands

Abstract

For granting quality to their customers, the container glass industry relies on inspection tools, at first mainly in the cold end, since 2000 also in the hot end. These tools are essential but ultimately only reactive safeguards identifying defective containers after they are formed. Drawing on 25 years of experience with hot end image processing and glass manufacturing, this paper argues that the industry is poised for a far more transformative shift. While inspection remains a critical application, our work demonstrates that the true potential lies upstream: in understanding the root causes of defects, enabling real time process control, and reducing operator dependency in the hot end.

Through decades of field deployment and continuous research, we have developed systems that not only detect anomalies but also interpret them in the context of forming dynamics, machine behavior, and environmental variation. These insights reveal a persistent imbalance: glass makers overwhelmingly invest in end of line rejection, while the actionable intelligence required for defect prevention remains underutilized. As a result, significant opportunities for efficiency gains, productivity improvements, and lightweighting remain unrealized.

Our findings show that AI driven forming process control can substantially reduce defect generation, stabilize production, and support less operator dependent workflows. Yet the adoption of such capabilities is constrained not by technological readiness but by organizational and cultural inertia. Incremental upgrades to inspection systems alone will not reshape the industry; what is needed is a shift toward integrated, data driven manufacturing strategies.

This paper therefore calls for deeper collaboration between technology providers and glass manufacturers. By forming true partnerships—where insights, data, and long-term objectives are shared—we can accelerate the transition from reactive quality selection to proactive quality control and intelligent production. The potential impact is profound: fewer defects, lighter containers, more consistent quality, less operator dependency and a more resilient, future ready glass industry.

Keywords

intelligence, data-driven, control, collaboration, competitiveness

Bridging The Competitiveness Gap: Physics-AI Digital Twins for Energy-Efficient and High-Performance Hollow Glass Manufacturing

Federico Monegaglia

GlassFORM.ai, Italy

Abstract

The hollow glass industry is facing increasing pressure from rising energy costs and shrinking margins, despite its strong positioning as a sustainable packaging solution. Energy demand remains a key factor limiting competitiveness compared to alternative materials. To address this challenge, we developed Physics-AI Digital Twin-based solutions with a dual objective: reducing energy consumption while increasing productivity through reduction of defects, waste, and downtime.

This work presents a physically consistent modeling framework based on Physics-informed Artificial Intelligence, where Computational Fluid Dynamics (CFD) models are accelerated and approximated in real-time using AI techniques. These hybrid CFD-AI models are deployed as Digital Twins of key process units, including the forehearth conditioning system, the feeder, and the gob forming process.

The proposed approach enables real-time prediction of process states and optimization of control setpoints under varying operating conditions. By embedding these Digital Twins within advanced control strategies, the system continuously identifies energetically optimal configurations while ensuring target glass temperature and homogeneity.

Experimental validation on industrial use cases demonstrates that simultaneous improvements in energy efficiency and process stability are achievable. Results indicate measurable reductions in energy consumption alongside improved production consistency and reduced defect rates.

The presented methodology represents a step change in process control for the glass industry, demonstrating that “more with less” is not only theoretically feasible but practically achievable. This approach provides a scalable pathway to enhance competitiveness and sustainability, supporting the transition of hollow glass manufacturing toward more efficient and adaptive production paradigms.

Keywords

hollow glass, process control, forehearth, physics ai, digital twin

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Empowering Energy Transition: Innovations in Safe, Efficient & Accessible Battery Storage

Amy Zhiying Zhou

Great Power, China

Abstract

The global energy system is undergoing a fundamental transformation. Renewable energy sources such as solar and wind are growing rapidly, but their intermittent nature creates a critical gap between generation and consumption. Energy storage is the essential bridge that enables a reliable, resilient, and low-carbon energy system, particularly for energy-intensive industries such as glass manufacturing, which require continuous high-temperature operations and are highly sensitive to electricity prices and supply stability.

This work is based on Great Power's research, development and industrial practice spanning more than 20 years, covering grid-side and generation-side storage, commercial and industrial energy storage, residential and portable storage, and telecom backup power. Key performance indicators include safety records, cycle life, energy efficiency, low-temperature operability, and economic returns for end customers.

Three technology breakthroughs are highlighted. Flame-retardant gel electrolyte enables in-situ gelation and effectively prevents thermal runaway without compromising electrochemical performance. LTSC technology allows charging at -30°C and discharging at -40°C with charge/discharge efficiency of over 95%. Full-tab cylindrical battery design reduces internal resistance, improves current conduction efficiency, and extends cycle life, resulting in higher efficiency and lower total cost of ownership. Sodium-ion batteries and all-solid-state batteries are also covered for energy storage applications.

In real-world applications, systems have achieved zero safety incidents, cycle life exceeding 6,000 cycles, and peak demand reduction of 15–25%. Energy storage enables peak shaving, valley filling, demand charge management, renewable energy integration, and participation in demand response programs.

These results show that battery storage is technically mature and economically viable, and that cross-industry collaboration is essential to accelerate adoption.

Keywords

energy transition, battery energy storage, industrial decarbonization

Decarbonization with Nuclear Energy

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Abstract

Nuclear energy has been a strong ally to industrial development and fight against global warming since 1950s. It has been considered as base load carbon free electricity generator however the demand for energy shifted solely from electricity to electricity/high-temperature process heat especially for energy-intensive industries such as steel, cement, chemicals, refining, and hydrogen production. Current light water reactor fleet is not capable of meeting this new demand. Generation IV reactors offer a promising solution with their high outlet temperatures.

Recently, small modular reactor (SMR) technology which comes forth with modularity, factory fabrication, short construction time, and advanced safety feature attributions have accelerated worldwide especially for industrial application coupling. Their modular design enables deployment in remote locations and industrial clusters where secure, low-carbon energy supply is critical. Furthermore, SMRs can operate as part of hybrid energy systems, working alongside renewable energy sources such as wind and solar. The SMRs having Gen-IV design are especially important for decarbonization of energy-intensive industries.

Keywords

nuclear energy, generation-IV reactors, small modular reactors, process heat, decarbonization

Beyond the Furnace: Energy Transformation Across the Glass Plant

Cathalijn van Rijmenam & Mert Kalpar

Siemens, Switzerland

Abstract

Energy management in glass manufacturing has long centred on the furnace — and rightly so. Yet as the industry faces pressure to decarbonise, manage volatile energy costs, and navigate large-scale electrification, the rest of the plant is emerging as an equally important opportunity.

Siemens brings a consistent insight to glass manufacturing: energy performance starts with knowing exactly what you consume, understanding what that data reveals about your energy system, and acting on the energy flexibility it unlocks.

This session explores how this translates to the glass plant:

- Measure — An Energy Management System delivers granular, real-time visibility across both production processes and facility infrastructure — compressed air, chillers, and boilers. Defining, harmonising, and uniformly reporting energy measurement points, with the involvement of automation control, is a significant challenge that Siemens knows how to address.
- Analyse — Two complementary lenses bring the energy picture into focus. Inside the fence, a digital twin of the plant's multi-modal energy system simulates load scenarios, electrification pathways, and decarbonisation strategies — supporting confident investment decisions at site level. Outside the fence, energy market advisory services assess procurement risk, model budget exposure, and evaluate renewable sourcing options including (V)PPAs — ensuring decisions are equally grounded in commercial reality.
- Act — With visibility established and the energy system understood from both an operational and commercial perspective, flexibility becomes actionable — shifting and optimising auxiliary loads to reduce peak demand, manage Scope 2 exposure, and ease the burden of electrification. Adjusting the energy procurement strategy and targeted plant asset improvements offer further levers to reduce costs and Scope 1/2 emissions directly.

The furnace is the heart of the glass plant. The opportunity lies in managing the whole body.

Keywords

energy management, energy system twin, decarbonization, energy flexibility, electrification

Scaling up Perovskite Solar Technologies towards Gigawatt-Manufacturing with Vacuum Deposition Technology - A Western European Perspective on Next Generation Photovoltaics

Martin Fischer, Jens Baumann, Martin Dimer, Frank Löffler, Bruno Heimke

Von Ardenne GmbH, Germany

Abstract

Physical vapor deposition (PVD) processes hold great potential for industrializing the deposition of PVSK cell stacks. A variety of materials will be deposited by sputtering, thermal evaporation and related processes in Perovskite solar cell and module manufacturing. This presentation will share an insight into the risks and chances for scaling up vacuum related deposition technologies, with a special focus on transparent conductive oxides, metal oxides, organic and inorganic compositions.

Keywords

PVD, thin film manufacturing, solar cell

Melter Electrification and Competitiveness – Solving Challenges Across Glass Sectors and Geography

Bruno Malphettes, Syntia Metchueng, Wolf Kuhn, Andy Reynolds

Fives Stein, France

Abstract

After several years investigating multiple paths towards decarbonation, the opinion of glass technologists, investors and customers across the industry seem to converge on two conclusions, fueled by pragmatism, geopolitics and research: there is a growing desire to get rid of fossil fuels in glass melting and conditioning, and direct electrification is most obvious and the least painful path to decarbonization.

Questions however remain wide open: what is the precise pathway, what are the practical steps to take to electrify and when to implement them? Our certainty is that optimal answers exist for each plant, each rebuild and each investment, whatever the pressure of CAPEX, OPEX or schedule; the challenge is to remain flexible, with the right mix of creativity and rigor.

This paper will explore four different ways that have effectively been followed to combine significant electrification with efficiency and realistic business case. These different ways are not meant to be generalized but to illustrate the diversity of solutions as well as the key importance of innovating designs, serious modeling and forward-thinking implementation.

In the first two examples, we will describe two projects of partial electrification of a regenerative furnace in a highly constrained capex pressure – one of them for a Şişecam furnace. We will explain in both cases how we found the good compromise between ideal design and cost of implementation, and the actual results obtained.

In the next two examples, we will show how radical changes such as regenerative to recuperative and oxygas to all-electric have been found as the lowest total cost of ownership in specific contexts.

Across all four examples, we will also insist on the side benefits of technological upgrades that still can be factored to facilitate positive and de-risked decisions that make the industry evolve gradually in a radical and no-return direction.

Keywords

electrification, decarbonization, regeneration, oxyfuel, optimization

ENGINEERING

Solar Glass Manufacturing - State of the Art, Technological Developments, and Future Challenges in Furnace Design

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Abstract

Solar glass production is currently dominated by very large, high-throughput furnaces, particularly from Chinese market leaders, optimized for maximum pull rates and low specific costs. In contrast, many regional markets require flexible furnace concepts in the range of roughly 300–1000 t/d that still meet stringent demands on optical performance, process efficiency and decarbonization. This presentation focuses on alternative solar glass melting configurations across this capacity range and compares their technological and operational characteristics with large-scale reference plants.

The presentation highlights how the combination of advanced furnace design with electric boosting and oxy-fuel operation can increase thermal efficiency, improve melting and fining, and reduce specific energy consumption and CO_2 footprint. Different solar glass plant concepts within the 300–1000 t/d range are discussed to meet current customers' requirements for tailor-made project solutions. Particular emphasis is placed on achieving stable long-term operation and competitive productivity at mid-scale pull rates while maintaining high solar glass quality.

Another topic is the melting of antimony-free high-quality solar glass in these alternative furnace concepts. The presentation addresses refining strategies without antimony, batch and redox optimization, and their impact on solar glass quality, as well as implications for furnace design and operation. Finally, perspectives for deploying energy-efficient, low-carbon and antimony-free technologies in the rapidly growing global solar glass market are outlined, highlighting opportunities for differentiated, regionally optimized furnace solutions.

Keywords

solar glass furnace; 300 – 1,000 tpd melting capacities, electric boosting

Enabling Lightweighting Without Compromise: Securing the Future-Focused Transformation of Energy and Glass

Romain Pioch

Tiama, France

Abstract

As the industry gathers for the 40th Şişecam International Glass Conference to discuss a future-focused transformation of energy and glass, container lightweighting stands as a critical priority. It reduces raw material use, lowers energy consumption, and supports CO_2 reduction goals. However, it also introduces major manufacturing challenges. Reduced glass weight narrows process tolerances, destabilizes forming conditions, and increases the risk of complex defects.

This presentation highlights how TIAMA supports glassmakers through six connected pillars:

- Hot End Visibility: Advanced sensors ensure stable gob weight and optimal glass distribution, preventing thin walls and forming defects.
- Closed-Loop Automation: AI-driven systems maintain target gob weight, adjust forming parameters, and regulate mold cooling to stabilize production and reduce human error.
- True Traceability: Datamatrix coding links Cold End inspection to Hot End processes, enabling precise root-cause analysis at cavity level.
- Cold End Precision: AI classification and high-resolution inspection detect micro-defects in complex lightweight containers before they reach customers.
- Automated Lab Validation: Integrated testing, including capacity and pressure resistance, ensures products meet real-world performance requirements.
- Analytics & Optimization: Plant-wide data connects Hot and Cold End operations, enabling continuous improvement and confident process optimization.

By linking inspection, automation, validation, and analytics, TIAMA provides a complete gob-to-pallet approach. This enables manufacturers to safely scale lightweight while maintaining quality, efficiency, and sustainability-proving that energy and glass transformation can be achieved without compromise.

Keywords

lightweighting, quality, efficiency, sustainability, automation

LIFE SUGAR Project – First Industrial Test Results

Ernesto Cattaneo

Stara Glass S.p.A., Italy

Abstract

The LIFE SUGAR project aims at demonstrating that hydrogen production by steam reforming is a viable way for extensive heat recovery in energy intensive sectors like glass production. After demonstrating the solution in lab-scale, we are finally ready to share the first industrial test results, from the pilot installation in the Vetrerie Meridionali plant of Castellana Grotte (Bari, Italy). The final technology aims at a >15% energy saving and reduction of the carbon footprint of glass production.

Keywords

energy saving, heat recovery, decarbonization, steam reforming, hydrogen

Oxygen-Based Solutions to Enhance Utilization of Aging Container Glass Furnaces

Matthias Goerisch

Linde GmbH, Germany

Abstract

While there is significant focus on decarbonization and AI-related advances in glass manufacturing, the container glass industry is dealing with the near-term challenge of declining market demand coupled with the political uncertainties in the Europe and Middle East. Typically, air-fuel container glass furnaces are designed for a furnace campaign of 10 – 15 years. Rebuilding such a furnace entails significant capital investment. Further performance of a furnace may typically deteriorate as it ages. Under such circumstances, the ability to extend the furnace campaign by several months to a few years or increase throughput to design conditions could have a favorable short-term impact on the profitability of the furnace operation.

Linde provides a range of oxygen-based solutions for such air-fuel furnaces. This presentation will provide an insight and present three distinct solutions implemented on container glass furnaces in Asia-Pacific and Europe in the last 5 years.

The first case was a cross-fired furnace with severely collapsed checker packs resulting in a pull rate reduction of 11% versus design. Linde implemented a unique Target Wall Lancing solution that improved combustion efficiency in the melter and rebalanced heat distribution to increase pull rate back to the original design value.

In the second case, a pair of oxyfuel burners were installed at the hot-spot area of an aging end-port furnace to increase pull rate by 14% versus design to meet market demand.

The third case involved deploying a combination of solutions – hot spot boosting and under-port O2 lancing to achieve a pull rate increase of close to 25% versus existing values.

In summary: these recently completed industrial projects demonstrate that these technologies can be used on all-natural gas/air-heated glass melting tanks (where they have been in use for over 20 years).

Keywords

energy efficiency, flexible production, glass quality, market demand

Double-Digit Energy Savings with New Batch and Cullet Technologies

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Abstract

Batch preheating has been well known in the industry for several decades. Several companies operate such systems; however, most facilities do not yet recover heat before it leaves the chimney. Due to energy costs and CO_2 reduction, these installations will be more important in the future. The systems have evolved over the years. Especially batch drying inside the preheaters and the associated chemical reactions of batch need to be addressed. But also, the handling and charging of dry batch are areas that need to be carefully designed and considered. If all aspects are addressed thoroughly, these systems operate reliably and can exceed the furnace lifetime while showing double-digit energy savings. This paper will address the latest technology with the new dynamic Batch and Cullet Preheater.

Furthermore, two areas of particular concern to glass makers are reducing wear and minimizing the portion of fine material in scraping conveyors. For this reason, Zippe developed the innovative ZMART® Scraper Control System. Depending on the gob weight and quantity of gobs or hot bottles, this advanced control system module decides whether and at which speed the scraping conveyor operates. Furthermore, the required operating time is calculated individually and minimized. Standardized interfaces between the IS machines and the scraping conveyor control system supply the production data automatically. If required, these parameters can be entered and adapted manually via touch panel and thus allow a continuous and individual optimization of the process. In this way high operational flexibility is achieved, the operation time is reduced to a minimum and, above all, this cost-saving alternative is permanently available.

Recycling gains more and more in importance. What was already the norm in industrial countries a long time ago, is now on the agenda in almost all countries around the world. However, there are still big differences in the quality of the collection systems. In some countries the raw material glass is collected and sorted according to color; sometimes, however, it is collected completely mixed. The proportions of foreign substances (metals, ceramics, waste in general, etc.) also differ from country to country. Post-consumer glass recycling plants typically comprise conveying, crushing, screening, and sorting technology (for example CSP, all-metal separation, color sorting).

Keywords

batch preheating, energy efficiency in glass production, cullet recycling, scraper control system, glass manufacturing optimization

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Application and Potential of Microwave Heating for Energy Efficient Glass Technology

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Abstract

The production of glass is an energy-intensive process that requires temperatures exceeding 1400 °C and continuous furnace operation. As a consequence, the glass industry is associated with high energy consumption and significant CO_2 emissions. In the context of global climate targets and the goal of achieving carbon-neutral industrial processes, the development of energy- and resource-efficient technologies in glass manufacturing has become increasingly important.

Current strategies for improving sustainability in glass production mainly focus on increasing the proportion of cullet, implementing alternative fuels or green electricity, improving furnace design, and enhancing heat recovery systems. However, alternative heating concepts may also offer significant potential for improving energy efficiency.

Microwave heating represents an alternative approach. Based on dielectric heating mechanisms, microwave energy can be directly coupled into suitable materials, enabling rapid heating rates and potentially reducing overall processing time.

Our lab-scale, hybrid glass melting furnace based on microwave, plasma and resistive heating, can operate at furnace temperatures of up to 1650 °C with a glass throughput of over 1 kg/h. It is equipped with a 3 kW, 2.45 GHz microwave source for direct heating; a 10 kW, 2.45 GHz microwave plasma torch; and a 1.8 kW resistive bottom heating system. Based on experiments conducted using this setup the presentation will show and discuss glasses that can be heated efficiently by microwave radiation. Several challenges remain, including limited penetration depth in molten glass, temperature inhomogeneities, frequency- and temperature dependent absorption behavior, and technological as well as economic constraints related to scaling and system design. Opportunities and limitations are evaluated to assess the potential role of microwave heating as an alternative or hybrid technology for more energy-efficient glass processing and whether microwave-based technologies could contribute to future low-emission glass manufacturing.

Keywords

glass melting, microwave, CO2 emission

Challenges in Atomistic Simulations of Amorphous and Glassy Materials

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Abstract

Atomistic simulations have become indispensable tools for understanding the structure, dynamics, and properties of amorphous and glassy materials. Despite remarkable progress, key challenges still limit their predictive capability and their integration with experimental observations. This lecture will present a critical perspective on the current state of the field, focusing on oxide glasses and complex multicomponent systems.

Three major challenges will be addressed. First, the intrinsic gap between simulation and experimental timescales imposes unrealistically high cooling rates in molecular dynamics simulations, leading to deviations in structure and properties. Overcoming this limitation requires advanced sampling strategies and hybrid methodologies capable of accessing deeper regions of the energy landscape. Second, the development and validation of reliable interatomic potential remain a fundamental bottleneck. The absence of a unique reference structure in glasses complicates parameterization and demands rigorous validation frameworks combining structural, thermodynamic, and spectroscopic observables.

The third challenge concerns the accurate calculation of properties and their prediction through machine learning approaches. While data-driven methods have opened new avenues for predicting macroscopic properties and establishing structure–property relationships, their reliability critically depends on the quality and representativeness of training datasets, as well as on the physical interpretability of the models. Bridging atomistic structure with experimentally measurable properties—such as mechanical, transport, and spectroscopic responses—remains a central issue, particularly for complex and multicomponent glasses.

Keywords

molecular dynamics simulations, glasses, predictive models, machine learning potentials

Mathematical Modeling of Heat Transfer and Batch-To-Glass Conversion Kinetics in Commercial and Waste Glass Melting

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Abstract

A detailed understanding of heat transfer from the molten glass into the reacting batch, together with the kinetics of batch-to-glass conversion, is essential for optimizing the performance of all-electric glass melting furnaces and for ensuring reliable predictive capability of furnace models under varying feed compositions and operating conditions. To investigate the batch conversion processes, including silica dissolution, gas evolution, and the formation and decay of primary foam, a combination of X-ray diffraction, thermogravimetric analysis, high-temperature visual observation, and evolved gas analysis was applied to batch samples subjected to controlled heating rates.

Based on these experimental results, a coupled model of heat transfer and batch conversion kinetics was developed, linking the thermal history of batch particles with their conversion behavior and overall melting rate. The simulations demonstrate that incorporation of realistic conversion kinetics affects the predicted melting rate, showing the important role of particle temperature history in the melting process. In addition, a composition- and redox-dependent model for estimating high-temperature radiative thermal conductivity is presented. The results indicate that even small fractions of crystalline phases and gas bubbles at the batch–melt interface can substantially attenuate thermal radiation, thereby influencing the effective heat transfer into the batch during melting.

Keywords

batch melting, conversion kinetics, heat transfer, thermal radiation, modeling

Conditioning of Glass Waste for Recycling via Glass Laser Morphing

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Abstract

The transition toward a circular economy in the glass industry requires a precise understanding of waste glass streams and their suitability for high-quality recycling. This study, conducted within the framework of the EVERGLASS project, investigates the collection and characterization of a broad range of post-consumer and industrial glass waste sources, including container glass, flat glass, LCD panels, glass from electrical and electronic equipment, and pharmaceutical glass, among others. Particular emphasis is placed on chemical composition and key material properties—such as thermal parameters and viscosity—that critically influence re-melting behavior and product performance.

Samples were analyzed using X-ray fluorescence (XRF) and inductively coupled plasma spectroscopy (ICP) to determine oxide composition and contaminant levels. Thermal characterization included dilatometry and differential thermal analysis (DTA) to obtain the glass transition temperature, dilatometric softening point, and coefficient of thermal expansion (CTE), while hot-stage microscopy (HSM) was employed to derive viscosity–temperature curves. Results showed that Al_2O_3 increases viscosity at lower temperatures, whereas Na_2O exerts influence across a wider temperature range. Soda-lime and float glasses exhibited similar thermal behavior, supporting their combined use in sustainable Glass Laser Morphing (GLM) processes. In contrast, borosilicate glasses (e.g., labware, pharmaceutical) showed greater variability in both viscosity profiles and CTE, nevertheless GLM is particularly useful to process this glass system due to no limitations in temperature for the laser and additionally, the lower thermal expansion coefficient of the borosilicate glasses contribute to avoid cracking due to the faster cooling of the process. In any case, controlling viscosity along the process is critical since no mold is used.

All data have been compiled into the EVERGLASS database and will serve as input for numerical modeling of the laser melting and shaping process. Prepared glass powders have been delivered for laser processing trials, and comparative studies using mixed glass compositions melted in conventional furnaces are currently underway.

Keywords

glass waste, borosilicate, soda-lime, viscosity, composition

Acknowledgments

This project EVERGLASS has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101129967.

Advancing Circular Glassmaking: Sustainable Raw Materials for the Present and Future

Liam Wray

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Abstract

The glass industry is under increasing pressure to transition toward circular raw material supply chains particularly in the context of sustainability and cost optimisation.

Calumite, a granulated blast furnace slag by-product, has been successfully used in glassmaking for over 75 years. Calumite offers additional benefits in use such as energy, environmental and glass quality.

Building on this experience, Calumite UK is investigating the feasibility of other industrial by-products that can be processed to be used as a novel glassmaking raw material.

Previous laboratory studies have demonstrated that selected biomass ashes can be incorporated into container glass without compromising quality, while enabling lower melting temperatures and energy savings. Calumite UK have completed a 20-tonne plant-scale trial to assess processing behaviour, storage characteristics, and chemical variability. Challenges do exist; however, results indicate strong potential for biomass ash as a circular raw material supporting glass industry decarbonisation.

Keywords

industrial symbiosis; circular economy; raw materials; decarbonisation

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Innovative Vacuum Insulated Glass Manufacturing: Low-Temperature Metallic Sealing for VIG

Pekka E.J. Nieminen

Leadus Technology, China

Abstract

Early vacuum insulated glass technology relied on glass solder to seal edges and pump-out-ports for vacuum extraction. However, commercialization revealed significant drawbacks, including lengthy production cycles, limited scheduling flexibility, higher risks of leakage due to pump-out-ports, and compromised aesthetics.

The industry has increasingly shifted toward pump-out-port-free vacuum insulated glass, utilizing sealing in a vacuum environment to address these challenges. However, the high melting temperature of commonly used glass solder has made it difficult to manufacture fully tempered glass, failing to meet regulatory standards in many regions. Additionally, the rigidity and brittleness of glass solder joints increase the likelihood of leakage under stress or deformation.

To overcome these limitations, LEADUS developed an innovative low-temperature metallic soldering in vacuum environment process (No pump-out-ports) and, in 2019, became the first to achieve large-scale production globally. This method enables sealing at temperatures far below the annealing point of tempered glass, ensuring compatibility with fully tempered glass. The flexibility and ductility of metallic solder significantly improve durability under stress and deformation, minimizing the risk of leakage. Additionally, sealing in a vacuum environment eliminates the need for individual vacuum pumping, greatly enhancing production efficiency and product aesthetics.

This breakthrough represents a significant advancement in vacuum insulated glass technology, delivering improved performance, faster production, and compliance with international standards.

Keywords

vacuum insulated glass, sealing

Advancing Surface Performance: Next-Generation Laser Micromachining for Glass Functional Finishes

Sabri Alamri

Fusion Bionic GmbH, Germany

Abstract

This presentation connects natural surface phenomena with advanced laser-based material processing, demonstrating how bioinspired micro- and nanostructures—such as those found on lotus leaves or moth eyes—can be engineered onto technical materials.

A special focus is placed on glass processing and finishing, where tailored surface structures enable anti-glare, anti-reflective, and anti-soiling functionalities by controlling light scattering and surface topography—without the need for additional coating. The laser-based approach enables deterministic, chemical-free structuring across a wide range of materials, offering scalable and sustainable alternatives to conventional techniques such as sandblasting, coating deposition, or chemical etching.

Application examples highlight the versatility of these surface technologies in industrial and high-tech sectors, including optical components, sensor systems, photovoltaic modules, medical devices, and automotive surfaces, where multifunctional performance and durability are critical.

Keywords

laser processing; surface functionalization; biomimicry; microstructures

Next-Generation Smart Windows: Efforts Towards the Development of Smart Windows for Sustainable Energy Applications

Ashutosh K. Singh

Centre for Nano and Soft Matter Sciences (CeNS), India

Abstract

There is a great demand for smart partitions to serve as wide-area switchable gates for light transmission across defined spaces at offices, public locations, as well as homes. In addition, smart partitions can serve as canopy glasses for greenhouses, aiding in efficient crop harvesting. However, current partitions and windows only provide transparency and require permanent fixtures such as screens or curtains for adequate see-through visibility. Household ventilation and indoor lighting and temperature control are responsible for over 40% of global energy consumption, making energy-saving technologies critical. Smart windows have gained prominence as they optimize indoor light and heat transmission, reducing the usage of air conditioners, lights, and heaters. The challenge lies in developing cost-effective, power-efficient, and simple-to-fabricate smart windows. Our team has been working on designing affordable and functional smart windows that I will be discussing in this talk. By attending, you will gain insights into the latest technological advancements in smart windows and their potential for energy-saving applications.

Keywords

smart glass, electrochromic, energy storage, self-powered, zero-energy buildings

Notes

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Optical Modulation and Functional Performance in Smart Glazing Technologies

Berk Alkan, Canhan Şen

Şişecam & Teta Glass Technologies, Türkiye

Abstract

Smart glazing technologies are increasingly considered functional components of architectural and automotive glass, in which transparent surfaces must manage daylight, privacy, solar heat gain, visual comfort, durability, and manufacturability within a single material system. The central challenge is not simply to switch transparency, but to achieve a practical balance between electro-optical response, process tolerance, long-term stability, and scalable glass integration. In this context, polymer-dispersed liquid crystal (PDLC), suspended particle device (SPD), and electrochromic (EC) glazing represent three distinct materials approaches rather than interchangeable smart-glass solutions. PDLC systems primarily enable rapid privacy control via field-induced refractive-index matching between liquid-crystal domains and the polymer matrix. SPD glazing modulates transmission by aligning absorbing anisotropic particles, while electrochromic glazing relies on reversible redox and ion-insertion reactions in multilayer coatings to regulate solar energy more directly.

Particular attention is therefore given to mesogen selection, polymer–liquid-crystal phase morphology, curing conditions, formulation optimization, and electro-optical response behavior, especially regarding their influence on optical modulation efficiency, angular transparency, switching stability, and manufacturability. The interaction between liquid-crystal alignment, polymer-network formation, and interfacial optical properties is discussed from a materials-engineering perspective to better understand the functional limitations and scalability potential of next-generation smart glazing systems.

Overall, this work presents a materials-level comparison of PDLC-, SPD-, EC-, and PSLC-based smart-glazing technologies for architectural and automotive glass applications, with emphasis on electro-optical behavior, process integration, and practical functional performance. The discussion aims to clarify the technological trade-offs between different smart-glazing approaches while highlighting the emerging potential of LC-based polymer-stabilized systems for future energy-efficient and adaptive transparent surfaces.

Keywords

smart glass, functional materials, electro-optic, liquid crystals

Driving the Future of Smart Glazing: How Switchable Films and IR Coatings Will Redefine Light, Comfort, and User Experience

Han-Alexander Pothoven

DK Automotive Glass, Netherlands

Abstract

The role of automotive glazing is evolving rapidly, driven by new vehicle design concepts, electrification, and increasing customer expectations regarding comfort and user experience. This presentation provides an industry-focused overview of how switchable glazing technologies—such as polymer-dispersed liquid crystal (PDLC), electrochromic (EC), liquid crystal (LC), suspended particle devices (SPD), and their respective variants—are progressing from niche solutions toward scalable, high-volume automotive applications across the vehicle greenhouse.

As interest grows in applying switchable glazing to panoramic roofs, sidelites, and windscreens, achieving long-term performance under demanding automotive operating conditions becomes a key challenge for series production. The presentation therefore focuses on the practical combination of switchable films with infrared (IR) reflective coatings as an essential enabler for industrialization.

A key element of this approach is DK Automotive Glass's CMC (Cool Mirror Coating) process, which allows advanced IR-coated glazing systems to be processed directly, without the need for additional decoating steps. By preserving IR reflectivity across the entire surface, the CMC process increases the effective IR-reflective area by approximately 20–30%. Furthermore, applying the IR coating on surface 2 enables a significant reduction of heat absorption within the glazing unit itself, allowing temperature reductions of more than 30 °C in ceramic black printed areas. This is achieved without introducing disadvantages during glass bending or ceramic printing processes.

The presentation concludes with practical insights into how integrated switchable and IR-coated glazing systems can be transferred into automotive production, highlighting their potential to improve light management, thermal comfort, and overall user experience in future vehicle architectures.

Keywords

smart glazing, ir management, DK's Cool Mirror Coating (CMC), automotive scalable

POSTER PRESENTATIONS

18-19 JUNE 2026 İSTANBUL

AZS–Molybdenum Composite Refractories for Critical Glass Furnace Applications

Alessio Flora

REFEL S.p.A., IT

Abstract

Refractories used in the most critical areas of glass melting furnaces play a decisive role in determining furnace reliability, campaign life and final glass quality. While fused cast AZS (Alumina–Zirconia–Silica) refractories remain the industry standard due to their high corrosion resistance and absence of open porosity, their performance may become limiting under severe molten glass flow conditions, particularly in throat and submerged areas.

This presentation focuses on a unique solution developed by REFEL, based on an AZS–Molybdenum composed structure refractory, commercially known as 1240 FVMo. The product combines a high zirconia fused cast AZS matrix with a fully embedded molybdenum reinforcing element, strategically positioned in the most corrosion exposed zones of the block.

Operational experience shows that, once the outer AZS layer is progressively consumed, the molybdenum insert effectively limits further corrosion, contributing to a significant extension of service life in critical furnace components.

With growing industrial pressure to replace chromia based refractories due to environmental, health and disposal concerns, AZS–Molybdenum composed structures offer a technically proven and environmentally compatible alternative. Moreover, current trends toward higher furnace efficiency, longer campaigns and reduced operational risk have renewed interest in solutions capable of extending refractory life in the most demanding furnace areas.

Overall, the AZS–Molybdenum composed structure demonstrates how an established and well engineered refractory concept can provide highly effective solutions to today's most demanding glass furnace applications.

Keywords

AZS-Molybdenum, Refractory, Composite Materials, Corrosion

Femtosecond Laser Surface Structuring of Glass for Anti-Reflective Applications

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Abstract

The reflection at a dielectric–air interface is given by $R=(n-1)^2 / (n+1)^2$, where n is the refractive index. For glass ($n \approx 1.5$), a two-surface panel reflects nearly 8% of incident light, which is a major loss for photovoltaic systems with efficiencies typically between 20–25%.

Conventional anti-reflective (AR) coatings reduce reflection by depositing thin buffer layers with tailored refractive indices and thicknesses. However, these coatings rely on wavelength-dependent interference effects and therefore cannot provide optimal performance across the full solar spectrum.

An alternative approach is the fabrication of sub-wavelength surface structures. When the structure period is smaller than the wavelength, the light experiences the effective refractive index of material producing the structure. These structures gradually modify the transition between air and glass, effectively changing the refractive index experienced by light and significantly reducing reflection over a broad wavelength range.

In this work, Laser Induced Periodic Surface Structuring (LIPSS) was used to create sub-wavelength patterns on glass surfaces using a femtosecond (fs) laser. For this project, an optical fiber fs-laser operating at 1030 nm was developed, delivering 350 fs pulses with energies up to 10 µJ. Since glass requires photon energies of about 3.6–4 eV for absorption, while 1030 nm photons provide only ~1.2 eV, the process relies on nonlinear multi-photon absorption enabled by high peak intensities.

The developed system successfully produced periodic structures directly on glass surfaces without additional processing. Current structures have periodicities near 1 µm, which can still cause scattering in the visible range. Ongoing work focuses on HSFL formation, pulse optimization, and angled irradiation to reduce feature size and further decrease surface reflectivity.

Keywords

femto-second lasers, anti reflection coating, laser induced periodic surface structuring,

Notes

The research is done under 1004-TFTP (20AG002) project, funded by TÜBİTAK.

New Raw Materials Opportunities: Overview and Anorthosite Case Study

Aston Fuller

Glass Futures, UK

Abstract

Glass Futures is a not-for-profit, membership-based, research organisation, based at its Global Centre of Excellence in St Helens, UK. The remit of the organisation is to enable its members from across the glass supply chain and beyond to collaborate in areas which affect all parties, with a particular focus on decarbonisation of the glass-making process and its upstream and downstream activities. One key area of interest is in the development of raw materials which are cost-effective, resource-efficient, energy-efficient and low-carbon.

At the heart of the new Glass Futures' facility is a 30 tonnes/day pilot-scale glass furnace, which has been designed to enable the industry to develop and trial new technologies at an industrially relevant scale, without risk to their commercial manufacturing assets, thus providing increased confidence for manufacturers looking to invest in low-carbon technologies such as alternative fuels, CCUS technologies and new raw materials. The pilot line has a state-of-the-art, flexible batch house with eleven material silos.

Following the completion of the alternative fuels trials in Q1 2026, Glass Futures and its members will embark on a programme of trials centred around batch and raw materials developments – an overview of this programme will be presented in the first half of this paper.

The second half of the paper will focus on an opportunity to develop anorthosite, currently in use in the insulating wool and fibre sectors, as an Al2O3-bearing raw material for the container and float sectors. Glass Futures and its 30 tonnes/day pilot-scale glass furnace provides the ideal environment for this development. Currently, container and float manufacturers in Europe have little to no choice of Al2O3-bearing raw materials – development of anorthosite would improve choice and therefore the competitiveness of the material prices. In addition, previous data from wool and fibre suggest that anorthosite may enable more efficient energy usage in the furnace.

Keywords

decarbonization, glass manufacturing, alternative raw materials, anorthosite, pilot-scale furnace

Circular Photovoltaics: Low-Temperature Delamination for Glass Substrate Reuse

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Abstract

Legacy photovoltaic (PV) modules were not originally designed with recyclability in mind, making the recovery of raw materials challenging and often limiting them to lower-value applications. To address these limitations, a transition toward sustainable, next-generation PV designs is crucial. Such designs can facilitate the efficient valorization of secondary resources and significantly reduce the environmental impact of the rapidly expanding solar industry.

In this study, an innovative approach has been adopted to ensure PV glass is recovered undamaged during the process. In this way, unlike traditional methods such as destructive recycling or downgrading, the obtained glass is made ready for the next PV module production. For this purpose, a sacrificial layer was introduced between the PV glass and the POE encapsulant. After scanning various materials, the most suitable material for this purpose was identified, and solution-based coating processes have been initiated.

After prototype production, solvent-based tests were conducted to assess delamination processes. Using a basic solution, the glasses were successfully separated without damaging the device stack. Following the successful results, a second stage involved designing a 50 cm x 50 cm module. Then, the damp heat test was conducted by keeping fabricated modules in climate chambers at 85°C temperature and 85% relative humidity (RH). It was determined that the structure maintained its original condition for 200 hours.

This study demonstrates that the proposed method has strong potential to contribute to future PV design standards and to support the development of more effective circular-economy approaches.

Keywords

sustainability, end-of-life management, design for recycling, material recovery, delamination

Notes

This work was supported by the APOLLO project, which has received funding from the European Commission (HORIZON EUROPE) under the grant agreement No. 101122277.

Using AI to Improve Batch Glass Detection: a Case Study on Glass furnaces

Fatih Vurtak, Philippe Kerbois

AMETEK LAND, France

Abstract

Effective control of batch coverage on the melt line is critical for maximizing glass furnace efficiency and ensuring consistent product quality in glass manufacturing. In this presentation, we introduce a next-generation approach that leverages a new AI-driven batch coverage detection module within LAND's Image Pro Software, seamlessly integrated with the high-resolution thermal imaging capabilities of the LAND NIR-b-2K (Near-Infrared Borescope).

By capturing real-time, near-infrared thermal data inside the furnace, the NIR-b-2K with Image Pro provides a detailed view of both surface temperatures and batch distribution. The Image Pro Software then applies advanced AI algorithms to pinpoint the exact location and extent of the batch coverage on any zones of the melting area. This allows operators to make immediate and informed adjustments to heat inputs, batch feed rates, and furnace parameters. Furthermore, the system's continuous monitoring and machine learning capabilities automatically detect emerging anomalies—such as cold spots, hot spots, or refractory wear—before they escalate into costly downtime events.

Case studies demonstrate how this integrated solution leads to consistent product quality, improved furnace throughput, and significant energy savings. By focusing on precise control of batch coverage, glass plants can reduce foaming formation, enhance melting efficiency, and optimize overall furnace performance. Attendees will gain practical insights into the implementation of AI-driven batch coverage detection, best practices for NIR-b-2K borescope integration, and strategies to realize both immediate and long-term operational benefits in modern glass furnace environments - regardless of the furnace technology employed.

Keywords

NIRB, Neural network, Thermal imaging, Image Pro Glass, AI

A Decarbonization Pathway: N_2O Emission Reduction by Topsoe Nshield™ Catalyst

Galen Kutlubay

TOPSOE A/S, Denmark

Abstract

Nitrous oxide (N_2O) is a powerful greenhouse gas, exhibiting 265 times the environmental impact of CO_2 while also damaging the ozone layer. N_2O is contributing significantly to global warming and is now the substance causing most ozone layer depletion. More industries are realizing that they might have N_2O emissions. Especially, usage of chemical binders in curing processes of certain industrial products' production such as mineral wool, could emit N_2O gas. NShield™ solutions convert N_2O into harmless air and water, enabling you to achieve very low cost of reducing the CO_2 equivalent footprint of your production. Typically, abatement costs are far lower than most CO_2 prices. The catalyst's unique monolith structure ensures low pressure drop and high efficiency, providing for combined N_2O and NOx abatement in a low-cost overall solution. As such, NShield™ ranks amongst the most cost-efficient technologies for greenhouse-gas reductions, making it an obvious choice for decarbonization. NShield™ solutions are currently reducing NOx and N_2O in sulfur containing tail gas streams. This provides unique possibilities for reducing N_2O emissions in a wide range of industries, such as curing chemical binders (for example: phenol-urea-formaldehyde (PUF) resin chemical). NShield™ is a high-activity monolith catalyst that can be designed to remove 99% of N_2O.

Keywords

nitrous oxide, greenhouse gas emission, decarbonization, catalyst,

Advanced Catalytic Ceramic Filtration System and Waste Heat Recovery Driving Environmental Policies and Energy Efficiency in The Glass Industry. The Case of The New Şişecam Kaposvár, Hungary Plant

Giorgio Di Lascio

Industrious Global Technologies Srl, Italy

Abstract

The glass industry faces stricter environmental regulations and increasing pressure to improve energy efficiency in line with the European Green Deal's net-zero targets by 2050.

To address this, IGT implemented a turnkey project for Şişecam's plant in Hungary, providing air pollution control and waste heat recovery systems for two furnaces. The solution uses advanced catalytic ceramic filters that simultaneously remove dust, NOx, SOx, and acid gases in a single system, reducing complexity and operational costs. The modular design allows capacity expansion over time.

Additionally, a waste heat recovery system captures energy from flue gases to heat water, supporting plant operations. This enables significant energy savings—equivalent to over 4 million Sm^3 of natural gas per year—and reduces CO_2 emissions by up to 8,000 tons annually.

Overall, the integrated system ensures compliance with European emission standards, improves efficiency, and supports sustainable, low-carbon glass production.

Keywords

decarbonization, energy efficiency, air pollution control, waste heat recovery

Surface Modification of Glass Through Brass-Based Conductive Primers: An Upcycling Approach

Göktuğ Günkaya, Nermin Taş

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Abstract

Glass is an electrically insulating material, which limits its direct metallization despite its widespread use in energy, architecture, and advanced material systems. Addressing this limitation, this study explores a brass-based conductive primer as a means of enabling direct metallization on glass surfaces through a simplified and adaptable approach.

The research focuses on the activation of clean glass surfaces without requiring any mechanical pre-treatment. A thin brass-based conductive layer is introduced onto the glass surface, followed by copper electroplating under low-voltage conditions. The method is applied to post-consumer waste glass—particularly window glass—and re-formed glass derived from everyday objects, supporting circular production models through upcycling strategies.

The findings indicate that the developed primer enables the formation of conductive layers across different glass forms, allowing controlled and selective metallization while maintaining the inherent qualities of the material. The process makes it possible to define clear boundaries between metallized and non-metallized areas, opening new possibilities for surface-based interventions on glass.

Rather than presenting a finalized functional system, this study positions metallization as a material-driven approach that activates the surface of glass and expands its potential beyond its conventional passive role.

Within the context of sustainable material transformation, the research highlights how value-added upcycling approaches can extend the functional and expressive capacities of glass through surface-oriented practices.

Keywords

glass coating, making electrically conductive surface, conductive priming, electroforming, upcycling

Organic and Perovskite Solar Cells for Building-Integrated Photovoltaics

Gönül Hızalan Özsoy, Pelin Oral, Elshan Asadi, Mustafa Yaşa, Görkem Günbaş, Selçuk Yerci

Middle East Technical University, Türkiye

Abstract

Building-integrated photovoltaics (BIPV) represent a promising pathway toward net-zero energy buildings by seamlessly incorporating solar energy generation into architectural elements such as facades, windows, and rooftops. Among emerging photovoltaic technologies, organic photovoltaics (OPV) and perovskite solar cells (PSC) are particularly attractive for BIPV applications owing to their tunable optical properties, mechanical flexibility, lightweight nature, and compatibility with large-area solution-based processing.

Organic solar cells offer excellent aesthetic versatility through tunable absorption spectra and semitransparency, enabling their integration into building facades and glazing without compromising architectural design. Perovskite solar cells, on the other hand, combine high power conversion efficiency with bandgap tunability, making them strong candidates for both opaque and semi-transparent BIPV modules.

In this work, we present the fabrication and characterization of organic, and perovskite solar cells developed at ODTÜ-GÜNAM.

For organic solar cells, PM6:Y6 was employed as the active layer, achieving a power conversion efficiency (PCE) of 16% for opaque devices, consistent with state-of-the-art literature values. Semi-transparent OPV devices were also fabricated, yielding a PCE of 12% with an average visible transmittance (AVT) of 24%. For PSC, a hybrid deposition approach was employed, combining thermal evaporation of inorganic precursors with solution processing of organic components. Wide-bandgap perovskite compositions ranging from 1.61 to 1.75 eV were developed, and device performance was further enhanced through the incorporation of self-assembled monolayers (SAMs), yielding PCE of 21% and 18% for 1.61 eV and 1.75 eV devices, respectively.

These results highlight the potential of OPV and perovskite technologies as viable candidates for next-generation BIPV applications, offering a versatile platform for aesthetically integrated and energy-efficient building envelopes.

Keywords

BIPV, organic photovoltaics, perovskite solar cells

Notes

OPV part of this study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grant Number 122F307. The authors thank TÜBİTAK for its support.

PSC work was carried out within the framework of the REFORM project (CETP-2022-00348), funded by the Clean Energy Transition Partnership (CETPartnership) Joint Call 2022, and by national funding agency TUBITAK (Türkiye, 223N002).

Crystallization Studies on CMAS ($CaO–MgO–Al_2O_3–SiO_2$) Glass for Enhanced Dimensional Stability

Gülseda Şenel, Emrah Dölekçekiç, Mert Gül, Hüseyin Boğaç Poyraz, Aydın Doğan

Eskişehir Technical University, Türkiye

Abstract

The performance of solid oxide fuel cells (SOFCs) under intermediate-temperature conditions (700–900°C) strongly depends on the reliability of sealant materials. In this respect, glass and glass-ceramic sealants are promising because they can provide gas-tight sealing, electrical insulation, and chemical compatibility with adjacent components. Their glass transition temperature (Tg) and coefficient of thermal expansion (CTE) can also be tailored to ensure sufficient softening, wetting, and thermomechanical compatibility during service. In the present study, B_2O_3-containing CMAS ($CaO–MgO–Al_2O_3–SiO_2$) glass system was investigated as a candidate sealant for SOFC applications. The glass was prepared by melting and quenching, and its thermal behavior was characterized by TG-DTA and hot-stage microscopy. Crystallization behavior was examined by X-ray diffraction and SEM after controlled heat treatments. The results showed that anorthite was the primary crystalline phase. Crystallization is important because the glass should first soften and flow to provide sealing, while subsequent crystallization can limit excessive viscous deformation and improve dimensional stability during operation. The dielectric behavior also indicated that the studied composition offers the electrical stability required for sealing applications. Overall, the findings suggest that B_2O_3-containing CMAS glass is a low-cost and barium-free candidate for intermediate-temperature SOFC seals.

Keywords

SOFC, CMAS glass, sealant, anorthite, crystallization

Green Synthesis of Mono-Color Photothermal Upconversion Nanoparticles via Laser Ablation of Y2O3:Yb3+/Er3+ Ceramic

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Abstract

This research introduces a green synthesis method for producing mono-color red-emitting upconversion nanoparticles (UCNPs) with inherent photothermal properties. Using a single-step, femtosecond laser ablation process, we achieve precise control over synthesis, reducing hazardous chemical usage and enhancing target reusability, thus making the method environmentally friendly. We initially optimized a ceramic engineering process for producing highly doped $Y_2O_3:Yb^{3+}/Er^{3+}$ ceramic targets, essential for maximizing laser ablation efficiency and limiting target degradation. This involved ball milling for nano-level homogeneity and comprehensive sintering optimization, followed by detailed characterization of the targets' crystal structure, microstructure, and photoluminescence (PL) and photothermal (PT) properties. The targets demonstrated impressive red upconversion luminescence and photothermal activity, making them suitable for laser ablation. We thoroughly studied the color and photothermal energy-conversion dynamics of both the targets and the synthesized photothermal UCNPs (PT-UCNP). Femtosecond laser ablation was selected to minimize laser-induced damage, resulting in well-dispersed sub-10 nm UCNPs with excellent photoluminescence and photothermal properties. The synthesized PT-UCNPs exhibit strong, single-color red emission at 660 nm, which falls within the biological window, and possess inherent photothermal activity without the need for additional photothermal agents. These findings underscore the potential of these dual-functional PT-UCNPs as fundamental components in broader strategies for advanced biomedical applications.

Keywords

rare-earth doped ceramics, photothermal upconversion nanoparticles (PT-UCNPs), mono-color red-emitting UCNPs, femtosecond laser ablation synthesis, green synthesis of UCNPs

Notes

This study was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK) under the Grant Number 2221 BİDEB, and we wish to acknowledge this support.

Effect of Dishwasher Detergents on The Surface of Soda-Lime-Silica Glass Products

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Abstract

The chemical durability of soda-lime-silica (SLS) glass is critical for applications exposed to cleaning agents. Detergents may cause surface degradation, optical haze, roughness increase, and long-term performance loss. This study compares the effects of detergents produced by Beyaz Kağıt and a competing manufacturer on SLS glass surfaces using an accelerated laboratory methodology.

Standardized flat glass samples were immersed in concentrated detergent solutions under controlled conditions. Surface degradation was evaluated through gloss measurements, mass change analysis, and roughness profiling. Morphological changes were examined by scanning electron microscopy (SEM), while compositional variations were investigated using energy dispersive X-ray spectroscopy (EDX).

Results showed that detergent formulation strongly influences both degradation severity and corrosion mechanism. Beyaz Kağıt products mainly promoted alkali ion leaching, producing an Al and Si enriched residual surface with visible haze formation. The competing product caused both alkali extraction and partial degradation of the silicate network, resulting in higher mass loss and greater surface damage.

The findings demonstrate that detergent chemistry plays a decisive role in glass corrosion behavior. The proposed methodology provides a practical framework for detergent-glass compatibility assessment and supports the development of formulations that minimize surface damage while preserving optical clarity and structural integrity.

Keywords

soda-lime-silica glass; detergent corrosion; chemical durability; surface degradation

Notes

The authors acknowledge all supporting institutions and collaborators.

Supply Chain Risk Management in Glass Packaging: Freight, Geopolitics, and Energy

Hüseyin Baştuğ

Video Analitik Bilişim Tekn. Ar-Ge Dan. Ltd., Türkiye

Abstract

Glass packaging manufacturers face an unprecedented convergence of structural disruptions: permanently elevated energy costs, freight rate volatility, geopolitical fragmentation across critical trade corridors, and the full activation of the EU Carbon Border Adjustment Mechanism in 2026. Risk models that treat these four pressures independently systematically underestimate exposure — their interdependence is not incidental but structural.

This talk proposes an integrated approach to supply chain risk management that treats these correlated pressures as a single system rather than separate problems. Drawing on simulations across key input variables — including TTF gas prices, Baltic Dry Index (BDI), container rates (FEU), soda ash supply scenarios, and Red Sea incident frequency — it examines how concurrent shocks propagate through production costs and what hedging and sourcing strategies can credibly absorb them. The talk argues that the glass sector has yet to sufficiently embrace the available tools — and that this is a reversible choice — while questioning what awaits manufacturers who have not yet built this capacity.

Keywords

supply chain risk, glass packaging, freight volatility, energy hedging, geopolitical scenario planning

Technological Change for Future Specialty Glass Production

Moritz Hauf, Lenka Deneke, S. Wolf, B. Bochtler, T. Golubeva, W. Schmidbauer, K. Jochem, S. Knoche, J. Costard, M. Hahn

Central R&D, SCHOTT AG, Mainz, Germany

Abstract

SCHOTT, a global leader in specialty glass manufacturing, is advancing innovative approaches for future glass production. Balancing ecological and economic aspects of production planning, we believe that future glass melting concepts must address three core areas: (1) the use of low-emission energy sources, especially electricity, (2) energy and process efficiency, and (3) flexibility to adapt to fluctuating energy prices.

The GIFFT project investigates flexible-fuel plasma burners as a key technology for cost-effective future melting processes. The burner utilizes existing oxyfuel gases combined with variable electrical boosting of flame power. This approach not only improves energy efficiency by reducing the amount of flue gas for the same power output but also provides short-term flexibility in electricity usage without compromising melting process stability. As installed renewable capacity increases, the grid will experience growing fluctuations in power output. Consequently, flexibility in electricity consumption can provide significant economic benefits by enabling dynamic adaptation to variable energy generation and market conditions. In addition, it will contribute to grid stability and can help facilitate the clean energy transition.

The PLANET1 project helps to lay the foundation for reducing CO_2 emissions for high-temperature glass-melting process through significantly enhanced electrical boosting.

The PROSPECT projects outline SCHOTT's path toward its first electric melting tank for premium pharmaceutical glass, which is scheduled to start operation in 2027.

Within the MiGWa project, we explored microwave-assisted glass melting, from fundamental tests to a lab-scale continuous melting tank.

Together, these projects illustrate SCHOTT's commitment to advance future glass melting technologies - combining electrification, process efficiency, and operational flexibility to create pathways for reducing carbon emissions in specialty glass production.

Keywords

Flexible-Fuel Plasma Burner, All-electric Melting, Energy Efficiency, Microwave Heating

Notes

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Glass–Gfrp Laminates with Pre-Tensioned 3d Cores: Enhanced Ductility and Load Capacity

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Ankara University, Türkiye

Abstract

This study investigates the use of mechanically pre-tensioned (MPT) 3D GFRP strips for improving the behaviour of glass beams. Monolithic glass is brittle and has a very low tensile strength (approximately 40 MPa). Laminated glass interlayers using polyvinyl butyral (PVB) have advantages in safety but have limited post-cracking load carrying capacity. A novel Glass-GFRP laminate system was developed to address these limitations. Core elements of the 3D GFRP core were fabricated with a modified VIP process, then pre-tensioned and bonded with a high-performance epoxy adhesive to glass sheets. The pre-tensioning induced compressive stresses to the glass which increased its apparent tensile strength and lowered the risk of catastrophic failure, inducing progressive ductile failure. Three-point bending tests were then performed on monolithic glass, PVB laminated glass, and pre-tensioned glass-GFRP laminated specimens. The pre-tensioned laminate showed considerable improvement in midspan load (0.529, 0.752, and 0.855 kN) as compared with monolithic glass (0. 283 kN) and a PVB laminated glass (0. 789 kN). The post-cracking behaviour was considerably improved: several finer cracks were formed, with up to 29 mm displacement capacity and larger energy absorption. Only the tensile side of the glass member exhibited cracking, while the 3D GFRP core and the compression side sheet remained intact. The results show that the use of pre-stressed 3D GFRP strips is effective for improving the load-carrying capacity, ductility and the fracture control of glass laminates. This technique can be considered as a valid, light and low thickness alternative in structural glass applications requiring transparency, high strength and controlled failure.

Keywords

Glass, Resin, VIP, 3D GFRP, Pre-tension

Notes

The authors acknowledge the support of the Scientific and Technological Research Council of Türkiye (TÜBİTAK). The authors also gratefully acknowledge Parabeam® BV (Helmond, Netherlands) for providing the 3D GFRP material used in this study.

Şişecam Polatlı Flat Glass Factory Digital Delivery and Receipt Project

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[3] Şişecam Polatlı Flat Glass Factory, Türkiye

Abstract

This project presents PANE AI, an AI-based digital delivery and receipt system developed for flat glass lot counting and quality verification at Şişecam Polatlı Flat Glass Factory. The purpose is to replace manual counting, which is vulnerable to human error, time loss and limited data capture, with a visual digital twin that records and verifies each transaction. The system uses barcode-triggered data capture, multi-angle camera scanning, deep-learning-based image processing and real-time SAP HANA integration. Within a 45–60 second cycle, PANE AI identifies the vehicle, guides the forklift driver, counts the lot, measures dimensions, distinguishes laminated and flat glass, verifies thickness, and decides whether the lot may proceed to storage or must be returned to production.

The innovation lies in combining computer vision, AI filtering under reflective glass conditions, autonomous decision-making and ERP-integrated traceability without dependency on a conventional PLC system. Field validation on 2,798 lots demonstrated over 99% achieved accuracy, exceeding the required 95% threshold. More than 100,000 labelled real factory images support continuous learning. The project concludes that AI-enabled visual inspection can remove warehouse bottlenecks, reduce counting errors, prevent incorrect deliveries, improve customer trust and create visual evidence for quality assurance.

Keywords

artificial intelligence; image processing; flat glass; digital twin; quality control

Earth Base "Earthian" Habitats: Indigenous-Informed, AI-Driven, Robotic-Infused Arctic Analogs for Space-Ready Habitation in Canada's North

Sait Aynacı

Earth Base, Türkiye

Abstract

As Arctic competition intensifies, Prime Minister Carney's strategy couples persistent presence with infrastructure and Inuit-Crown partnerships, making analog habitats imperative. EARTH BASE, an AI/ML/HCI-driven startup, proposes "EARTHIAN" habitats and habitant droids across extreme Canadian environments to prototype space-ready habitation while supporting Indigenous-partnered capacity building.

EARTHIAN features two self-sufficient systems: EARTHIAN-Fixed, an infrastructure-embedded base, and EARTHIAN-Portable, a redeployable seasonal habitat. Both emphasize bioclimatic performance and long-duration habitability as high-fidelity lunar and Martian analogs.

Architecturally, EARTH BASE fuses Indigenous knowledge, ancient traditions, and archaeoastronomical alignments via AI-driven parametric workflows. Solar phenomena, including solstices, equinoxes, polar twilight, and diurnal paths, encode design constraints shaping apertures, spatial organization, and communal choreography, supporting crew psychology and cohesion.

Technically, habitats leverage self-healing materials, in-situ resource utilization, and robust thermal-structural strategies against Arctic permafrost instability, thermal cycling, deformation, and wind loading. Robotic-first assembly uses modular, sensorized components for autonomous alignment, minimizing hazardous human exposure while providing an off-world construction analog. Merging engineering with ancient intelligence, EARTHIAN simulates human-robot teaming, generating space-ready inhabitants.

Grounded in Indigenous reconciliation, this paper presents: (1) EARTHIAN's AI/ML workflows; (2) the celestial-informed architectural framework; (3) robotic assembly and HCI operations; (4) an Arctic-to-orbit technology roadmap. This work communicates integrated socio-cultural and technical dimensions.

Keywords

analog habitats & missions, space & analog architecture, Indigenous knowledge + design, AI driven design, Robotics & ML

Earth Base's Earthian: Extreme Environment Habitats and Companion Droids as Analog Architecture for Analog Missions, Astronauts and Space Ready Inhabitants

Sait Aynacı

Earth Base, Türkiye

Abstract

This paper presents EARTH BASE, AI, ML, and HCI driven robotic design initiative integrating speculative habitats and companion droids throughout extreme terrestrial environments, establishing an innovative analog platform concerning forthcoming space habitation. EARTH BASE explores how territories across Planet Earth, spanning analog, polar, mountainous, desert, and subterranean contexts, can safely house distributed networks pilot bases. These infrastructures function jointly as installations for national defense, research, and humanitarian interventions, as universal cultural artifacts, and as training environments generating space ready inhabitants.

The project engineers autonomous, self assembling micro megastructures and robotic agents: AN aeronautical bot, E capsule, URU structure, QI terrestrial bot, A maritime bot, and GIRGIR droid. Each constitutes a key agent building block within multi modular architectures, utilizing expressive, timeless design vocabularies emphasizing quiet luxury and intimate sanctuaries. Leveraging Robotic infusion, AI driven design and behavioral models, and 3D additive manufacturing, advanced materials science and engineering, Vertically Integrated Closed Ecosystem (Hardware-Software Co-Designed), this progressive program simulates habitation scenarios spanning emergency rapid deployments toward long duration, semi autonomous settlements mirroring challenging constraints lunar and Martian encampments.

This manuscript delineates underlying architectural frameworks orchestrating advanced robotics, human robot interactivity, and sophisticated systems design, material systems supporting habitability, psychological wellbeing, and operational resilience throughout isolated circumstances. Mixed methodologies environmental monitoring, UX analytics, evaluate these technical systems.

Keywords

analog habitats & missions, space & analog architecture, indigenous knowledge + design, ai driven design, robotics & ML

Investigation of the High Temperature Behavior of Gas Turbine Blades under CMAS Exposure

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Abstract

CMAS (Calcium-Magnesium-Alumina-Silicate) is a glass-like melt or deposit that can cause serious damage in gas turbine engines operating at high temperatures. This structure forms when particles such as desert sand, volcanic ash, sea salt, and burnt ash infiltrate the engine. Melting at high temperatures and transforming into a fluid phase, CMAS poses a significant threat, particularly to Y2O3-stabilized-ZrO2-based (YSZ) thermal barrier coatings (TBCs) on turbine blades. Molten CMAS penetrates the porous structure of the TBC, infiltrating the coating and causing stress and cracking.

This study investigates the behavior of a TBC on a nickel-based superalloy turbine blade under the influence of CMAS. In this context, a CMAS composition was produced, pelleted, and applied to the turbine blade surfaces in a controlled manner. Subsequently, operating conditions were simulated using heat treatments performed at 1300°C for varying time intervals. Five different samples prepared for this study were evaluated comparatively. The samples were characterized using stereomicroscopy, scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDX). Furthermore, the thermal behavior of the CMAS frit was evaluated using heat microscopy and DTA/TG techniques.

The investigations revealed microstructural degradation, elemental distributions, and surface morphological changes in the coating structure due to CMAS interaction at elevated temperatures. The results showed that the damage mechanism progressed gradually with increasing CMAS exposure time at 1300°C. In particular, it was determined that the coating system largely lost its microstructural and chemical integrity after 3 hours of exposure. CMAS infiltration into pores, dissolution of the YSZ phase, and transport of elements towards the metal substrate were identified as the main factors limiting coating performance and service life of the turbine blade.

Keywords

turbine Blade, thermal barrier coating (TBC), YSZ, CMAS, high temperature behavior

8 Years of AI in Glass Inspection: From Promise to Proven Industrial Experience

Sonia Debets

IRIS Inspection Machines

Abstract

Over the past years, Artificial Intelligence has been increasingly deployed in glass manufacturing, particularly in cold end inspection systems. AI-based approaches, driven by machine learning and deep learning, have been able to improve defect detection and classification and to allow early defect prediction linked to the forming process. These developments have raised expectations regarding reduced operator dependency and measurable gains in pack-to-melt.

This presentation addresses a key question: what is the real impact of AI in glass inspection today? It is following our previous work on defect prediction using Evolution range inspection systems and collective intelligence;

Based on 8 years of field experience across multiple glass plants where AI-based Evolution inspection systems have been implemented, IRIS presents a clear return on experience. The analysis highlights how different AI strategies have led to different operational outcomes across the industry.

Rather than a “miraculous” solution, AI proves to be a flexible toolbox. Through concrete case studies, we demonstrate that AI can deliver measurable improvements in quality, efficiency, and process understanding. However, these benefits depend on the experience input, defining the right quality targets and avoiding over-quality, which can impact overall performance.

This presentation provides a pragmatic, experience-based overview to help industry stakeholders better understand where AI creates value in cold end inspection, and how to implement it effectively.

Keywords

artificial intelligence, digitalization, defects prediction, real-time monitoring, sustainability