中国建筑材料联合会
China Building Materials Federation

2023

全球建材十大科技新闻

Global Building Materials Science and Technology News Top10

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2023 Global Building Materials Science and Technology News TOP 10

1. A UK-Based Project Trialling the World's First Zero-Emissions Cement on an Industrial Scale

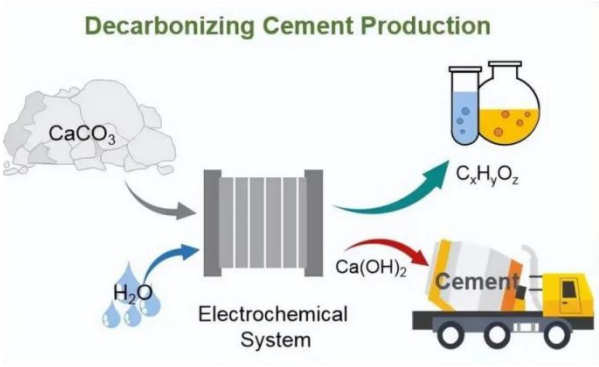
10 February, as reported by International Cement Review, Cement 2 Zero, a UK-based project trialling the world's first zero-emissions cement on an industrial scale, was officially launched having successfully conducted the first in a series of pilot-scale melts. The project would investigate both the technical and commercial aspects of upscaling Cambridge Electric Cement (CEC) production to produce 20t of the world's first zero emissions cement. The Cement 2 Zero project aims to demonstrate that concrete can be recycled to create a slag forming addition which could, when cooled rapidly, replace Portland cement. Therefore, CEC could be made in a virtuous recycling loop, that not only eliminates the significant emissions of cement and steel production, but also saves raw materials.

Source: Materials Processing Institute

2. Nankai University Proposed the Method of Electrochemical Transformation of Limestone into Calcium Hydroxide and Valuable Carbonaceous Products for Decarbonizing Cement Production

17 February, according to the report of iScience, a research team from Nankai University demonstrated an in situ electrochemical process that transforms $CaCO_3$ into portlandite ($Ca(OH)_2$, a key Portland cement precursor) and valuable carbonaceous products, which integrates electrochemical water splitting and CO_2 reduction reaction with the chemical decomposition of $CaCO_3$. With different metal

catalyst electrodes, researchers have achieved various valuable carbonaceous products, such as CO, formate, methane, ethylene, and ethane during the electrochemical CO_2 process. The electrochemical process could be driven by renewable electricity. This design enables in situ conversion of CO_2 during cement production, which converts the CO_2 into valuable carbonaceous products. It provides a green and sustainable path for cement production.



Source: iScience

3. Spain's Pamesa Group and U.S.-Based eCombustible Energy Partner to Launch the First Carbon-Free, Hydrogen-Based Fuel Used in Ceramic Production

15 June, as reported by PRNewswire, Pamesa Group has used a hydrogen-based fuel to replace natural gas in its production process in partnership with eCombustible Energy. It is a new carbon-free fuel that is generated through an improved electrolysis process and with significantly higher production efficiency than any other electrolysis technology. This fuel provides a more efficient solution than existing hydrogen alternatives, including conventional green hydrogen, while remaining 100% carbon-free at a more competitive price than natural gas.

Source: eCombustible official website

4. Sublime Systems, An U.S.-Based Company, Uses Electrochemical Reactions to Produce Calcium-Based Cementitious Material at Room Temperature

24 June, according to the report of MIT Technology Review**,** Sublime Systems (Sublime) , which launched by Canadian chemist and MIT professor, has invented a new way to make cement. Sublime uses electrochemical reactions to produce lime using off-peak renewable electricity rather than high temperatures to make its cement, avoiding the need to burn fossil fuels and do not release CO_2. The resulting Sublime cement will then be sold as a mixture of the reactive calcium and reactive silicon. When water and gravel is added, the chemical reaction begins and the mixture starts to harden into concrete. Calcium is then mixed with other ingredients to form a cementitious material that can be used as a direct replacement for cement. This cementitious material has the same or better strength, slump and durability compared to Portland cement. This process significantly reduces carbon emissions relative to conventional cement manufacturing methods and is the first cement production process to eliminate both limestone emissions and fossil fuel emissions from high temperature combustion processes.

Source: MIT Technology Review

5. World's First Demonstration Test of Glass Production Using Ammonia as Fuel in Actual Production Furnace was Succeeded in Japan

27 June, AGC announced that it has succeeded in the world's first demonstration test of architectural glass production using ammonia as fuel in an actual production furnace. For this 2-day project, compared with conventional combustion methods using heavy oil as fuel under various conditions, the effects on the quality of glass, furnace materials, and control of the flame temperature, furnace temperature, and

NOx emissions were verified. In this test, the NOx concentration in the exhaust gas was found to be below the environmental criterion value while maintaining the required temperature of the glass melting furnace.

Source: AGC official website

6. U.S. Researchers Develop a New Low-carbon, Highly Crack-Resistant Glass

3 July, TechXplore reported an invention, called LionGlass and engineered by researchers at Penn State, requires significantly less energy to produce and is much more damage resistant than standard soda lime silicate glass. With LionGlass, the melting temperatures are lowered by about 300 to 400 degrees Celsius, which leads to a roughly 30% reduction in energy consumption compared to conventional soda lime glass. LionGlass is at least 10 times as crack-resistant compared to standard soda lime glass, which forms cracks under a load of about 0.1 kilograms force. The improved strength of LionGlass means the products created from it can be lighter weight. Since LionGlass is 10 times more damage resistant than current glass, it could be significantly thinner.

Source: TechXplore

7. Glass Substrates for Next-Generation Advanced Packaging Unveils

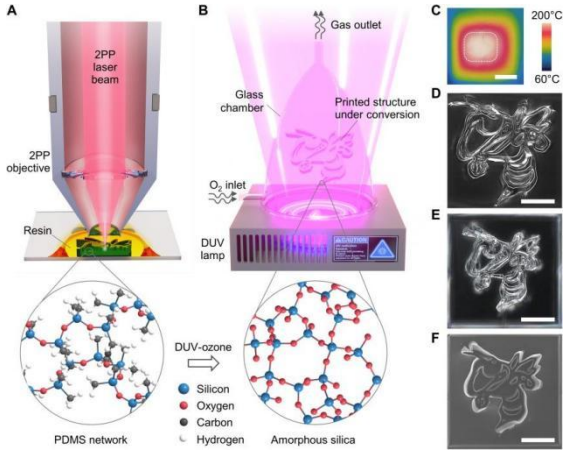
18 September, Intel announced one of the industry's first glass substrates for next-generation advanced packaging, planned for the latter part of this decade. This breakthrough achievement will enable the continued scaling of transistors in a package and advance Moore's Law to deliver data-centric applications. As the demand for more powerful computing increases and the semiconductor industry moves into the heterogeneous era that uses multiple "chiplets" in a package, improvements in signaling speed, power delivery, design rules and stability of package substrates will be essential. Glass substrates possess superior mechanical, physical and optical properties that allow for more transistors to be connected in a package, providing better scaling and enabling assembly of larger chiplet complexes (called "system-in-package") compared to organic substrates in use today. Chip architects will have the ability to pack more tiles – also called chiplets – in a smaller footprint on one package, while achieving performance and density gains with greater flexibility and lower overall cost and power usage.

Source: Intel official website

8. U.S. Research Team Developed Low-Temperature 3D Printing of Transparent Silica Glass Microstructures

4 October, according to the report of Science Advances, the research team of Georgia Tech Institute for Electronics and Nanotechnology developed a photochemistry-based strategy for making glass structures of micrometer size under mild conditions. The technique uses a photocurable polydimethylsiloxane resin that is 3D printed into complex structures and converted to silica glass via deep ultraviolet

(DUV) irradiation in an ozone environment. The unique DUV-ozone conversion process for silica microstructures is low temperature (~220℃) and fast (<5 hours). The printed silica glass is highly transparent with smooth surface, comparable to commercial fused silica glass. This work enables the creation of arbitrary structures in silica glass through photochemistry and opens opportunities in unexplored territories for glass processing techniques.

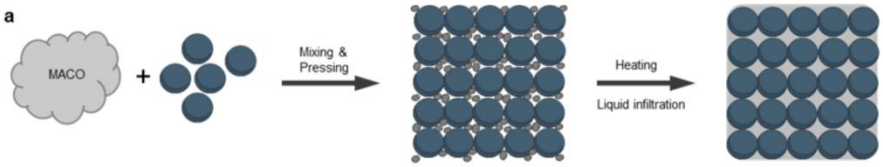


Source: Science Advances

9. Chinese Academy of Sciences Made Breakthrough Progress for A New Viscoelastic Inorganic Glass in Energy Storage

10 October, as reported by Nature Energy, Institute of Physics, Chinese Academy of Sciences achieved a remarkable breakthrough by discovering a new class of viscoelastic inorganic glass (VIGLAS) $MAlCl_{4-2x}O_x$ (MACO, M = Li, Na, $0.5 < x < 1$) with transition temperature (T_g) well below room temperature (RT) ($T_{g\ Li}$ = −16.8℃ and $T_{g\ Na}$ = −25.5℃). The VIGLAS can be synthesized through adding high content of oxygen into tetrachloroaluminates ($MAlCl_4$, M = Li, Na) to replace chlorine. This substitution not only initiates a transformation from fragile molten salts to resilient viscoelastic glasses but also leads to a notable surge in ionic conductivity to the level of mS cm^{-1} (1.52×10^{-3} S cm^{-1} for LACO75 and 1.33×10^{-3} S cm^{-1} for NACO75 at 30℃). VIGLAS electrolytes with sufficient chemical stability are able to withstand high-voltage (4.3 V) decomposition, and their polymer-like viscoelastic nature endows the capacity to withstand deformation under pressure-less (<0.1 MPa) operational conditions. Besides, VIGLAS electrolytes exhibit excellent scalability

with easy processability and cost-efficiency. This VIGLAS bridges the gap between the traditionally rigid nature of inorganic glasses and the flexible characteristics of polymers, and is a new class of materials with exceptional promise for applications in energy storage and beyond.



Source: Nature Energy

10. World's First Electric Tunnel Kiln for the Production of Sanitary Ceramics was Successfully Commissioned by Roca Group in its Austrian Plant

28 November, Roca Group announced the company has invested in the world's first electric tunnel kiln for sanitaryware at its Laufen plant in Austria. Given the kiln is highly efficient, decarbonised, and automated, it provides a valuable alternative to conventional production dependent on fossil fuels, The Laufen plant, which already uses electricity from renewable sources, was chosen for the first implementation of this pioneering technology as it is particularly conducive to the manufacture of the latest products of the highest quality. The innovation of the electric kiln has already been registered by the European Patent Office. The first production results of the new kiln system show great potential for the entire industry, because not only sanitaryware production can benefit from this new technology, but also other ceramic sectors such as structural and technical ceramics or tableware.

Source: Roca official website