

2024 Global Building Materials Science and Technology News TOP 10

1. Rice University develops new technology to convert glass fiber reinforced plastic waste into high-value silicon carbide

On February 29, an article titled *Flash upcycling of waste glass fibre-reinforced plastics to silicon carbide* was published on *Nature-Sustainability*, introduced a solvent-free, high-efficiency flash carbon thermal reduction recycling method. The method was proposed by Professor James M. Tour of Rice University and Professor Yufeng Zhao of Corban University. It can convert a mixture of different fiber-reinforced plastics into silicon carbide ultra-fast, with a conversion rate of more than 90%. By adjusting the operating conditions, two different phases of silicon carbide, 3C-SiC and 6H-SiC, with high purity can be selectively synthesized. The silicon carbide powder prepared using this technology can be used as a negative electrode material for lithium-ion batteries, and the cost is as low as \$0.047/kg, which is 0.2% and 3.4% of the dissolution method and incineration method, respectively. Compared with other fiber-reinforced plastic processing methods, this flash recycling method can greatly reduce energy consumption, greenhouse gas emissions and water consumption.

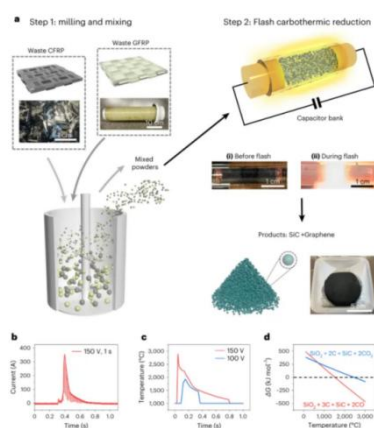


Figure 1: Upgrading FRP to SiC via FCR

Source: Nature Sustainability

2. Fives and Holcim achieve more than 50% hydrogen substitution in cement production

On March 8, according to *the International Cement Review*, Fives Group is supporting Holcim in its energy transition and the decarbonisation of its production processes. Fives has carried out hydrogen tests with Holcim at the La Malle site in France, which have made it possible to achieve a hydrogen substitution rate of more than 50%, a result unprecedented in the cement industry, claims Fives. In addition, the project has significantly increased the rate of use of alternative fuels while maintaining the same quality of cement produced.



Figure 2: Fives Group's equipment at Holcim's factory
Image source: Fives Group

3. AGC Achieves Additional Success in Demonstration Test of Solar Panel Cover Glass Recycling

On March 25, according to the official website of AGC Co., Ltd., AGC has announced that it has succeeded for the first time in Japan in a demonstration test to recycle cover glass for solar panels into float glass at the AGC Kashima Plant's float glass production furnac. With the success of this test, AGC expects that cover glass can be used to make float glass, which has been considered technically difficult to achieve. Approximately 5 tons of cover glass used in this test was refined and supplied using the low-temperature thermal decomposition technology of Tokuyama Corporation. Recycling cover glass into float glass has been challenging due to the presence of components that enhance glass transmission. With the success of this test, it is expected that float glass, which has a high production volume, will serve as a suitable outlet for the horizontal recycling of cover glass.



Figure 3: Schematic diagram of recycling process
Source: AGC Group

4. Tsinghua University proposes a high entropy design idea and method for chip multilayer ceramic capacitors

On April 11, Science magazine published an article Ultrahigh energy storage in high-entropy ceramic capacitors with polymorphic relaxor phase proposed by Lin Yuanhua's team at Tsinghua University . This idea and method effectively reduced hysteresis loss by reducing the magnetic domain reversal barrier, and regulated the high atomic disorder of lattice distortion and grain refinement , thereby improving the breakdown strength of the prepared MLCC device . The research team prepared an MLCC with a high energy density of $20.8\text{J}/\text{cm}^2$ and an energy storage efficiency of 97.5% under laboratory conditions . This method and method are suitable for the preparation of high-performance dielectric materials for other energy storage and other related functions .

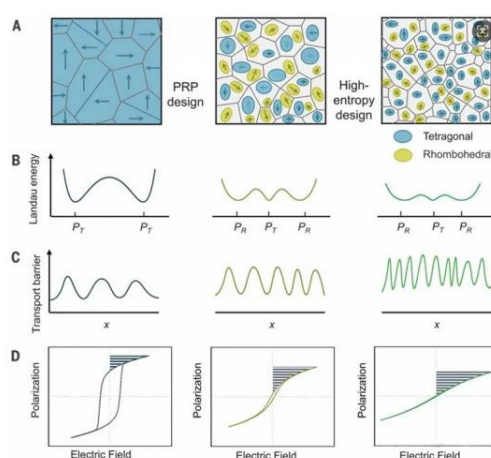


Figure 4: Schematic diagram of high entropy design strategy for ultra-high energy storage in polymorphic relaxation phase (PRP)

Source: Science

5. A research team from the University of Science and Technology Beijing proposed a strategy to increase the tensile deformation rate of ceramics to 39.9%.

On July 26, Science magazine reported that the scientific research team of Professor Chen Kexin from the University of Science and Technology Beijing and Yongjiang Laboratory, Professor Wang Jinshu from Beijing University of Technology, and Professor Huang Mingxin from the University of Hong Kong first proposed a "borrowed dislocation" to Strategies to achieve plastic stretching of ceramics. This strategy is to build an ordered bonding interface between molybdenum metal and lanthanum oxide ceramics, which significantly reduces the energy required to "transfer" metal dislocations into the interior of the ceramic, so that the ceramic can continue to "borrow" dislocations from the metal. , achieving a large number of construction and slippage of dislocations in ceramics at room temperature, and the dislocation density in ceramics is equivalent to the dislocation density in metals after the same amount of deformation, ultimately giving ceramics tensile plasticity similar to metals . Through the above means, the team achieved

room temperature tensile plasticity of ceramics for the first time in the world. The tensile elongation of ceramics can reach 39.9%, and the tensile strength is approximately 2.3 GPa.

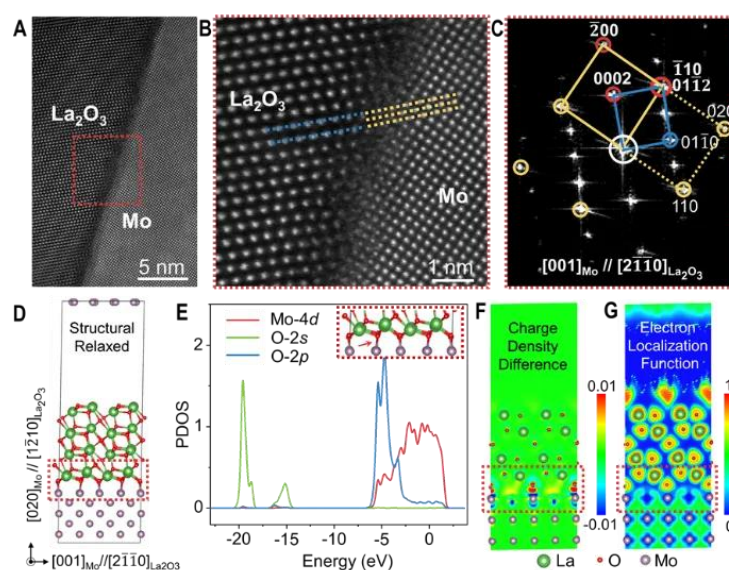


Figure 5: Mo-La₂O₃ ordered bonding interface structure and first-principles calculation results prove that the ordered interface is chemically bonded and the crystal plane is continuous

Source: Science

6. Wuhan University of Technology has developed a graphene current collector technology to improve the safety performance of energy storage batteries

On August 5, the magazine "Nature Chemistry and Engineering" reported that Professors He Daping and Mai Liqiang of Wuhan University of Technology and Associate Professor Yang Jinlong of Shenzhen University developed a non-metallic graphene aggregate that can be prepared on a large scale and has fast thermal response. fluid , the current collector can effectively regulate heat transfer and significantly improve battery safety . The graphene foil prepared by this current collector has ultra-high thermal conductivity (more than $1400 \text{ W m}^{-1} \text{ K}^{-1}$) , which is about one order of magnitude higher than Al foil and Cu foil. Soft-pack batteries assembled with the above-mentioned graphene electrode materials have faster heat dissipation performance, can effectively eliminate local heat concentration inside the battery, and can effectively avoid the thermite reaction and hydrogen evolution reaction caused by rapid heat release that cause thermal runaway of traditional battery packs. important inducement .

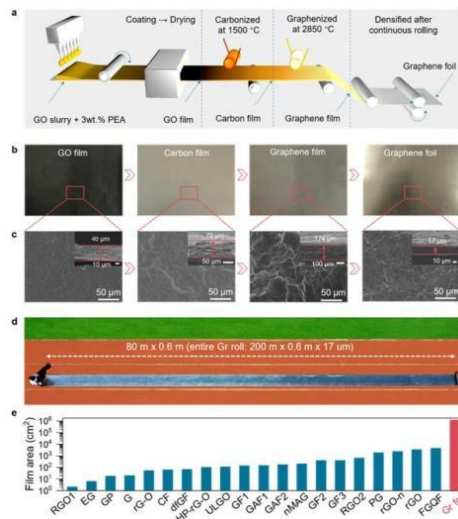


Figure 6: Large-scale preparation of graphene foil
Source: Nature Chemistry Engineering

7. Stanford University develops new gel material that can effectively improve the fire resistance of buildings

On August 21, according to Advanced Materials, Stanford University researchers have developed a new type of gel material made of cross-linking reactions between cellulose biopolymers and colloidal silica particles. It has ideal viscoelastic properties and is easy to manufacture. Studies have shown that under the impact of flames, the water in this material will be quickly lost, and the cellulose chains and silica particles will interact with each other. After the water evaporates, it will be transformed into a silica aerogel coating with high porosity and thermal insulation, becoming a solid physical barrier that can block flames. Compared with existing gel products, the barrier performance is improved by more than five times. This gel is very stable during storage, can be easily sprayed with standard equipment, and can adhere well to various surfaces. The gel is made of non-toxic ingredients and can be easily decomposed by soil microorganisms, which is safe for humans and the environment.



Figure 7: Schematic diagram of the seamless transition of the hydrogel into a strong aerogel shield after heating
Source: Advanced Materials

8. China Minmetals Corporation has developed ultra-high purity graphite products with a purity of more than 99.99995%

On September 3, Xinhuanet reported that China Minmetals Corporation has taken the lead in overcoming the key technology of high-temperature graphite purification and successfully developed ultra-high purity graphite products with a purity of more than 99.99995%. China Minmetals Corporation's graphite research team has independently developed continuous graphite purification processes and equipment in cooperation with leading equipment manufacturing companies in the industry, integrating physical and chemical purification, low-temperature and high-temperature continuous purification, ultra-high vacuum purification and other technologies to achieve the step-by-step purification of graphite products, increasing the purity of graphite from 95% to more than 99.99995%, and maintaining stable product quality, marking that my country's ultra-high purity graphite products have reached the international leading level.



Figure 8 : Ultra-high purity graphite
Image source: China Minmetals

9. China Building Materials Federation released six breakthrough new technologies and products for the first time

On November 17, CCTV's "Morning News" reported the first "Superior Products and Advanced Industry" Breakthrough New Technology And New Product Launch Conference held by China Building Materials Federation. Southeast University released the world's first cement aerogel , using cement as a raw material for the first time, and through the bionic cuttlefish bone structure, it prepared a low-cost cement aerogel with Class A fireproof, lightweight, high strength, and super hydrophobicity ; Wuhan University of Technology released the world's first carbon mineralization multifunctional inorganic coating material . The preparation process of this product is low-carbon, and it can absorb and fix carbon during use, and has antibacterial and self-cleaning functions ; BBMG New Building Materials Industrialization Group Co., Ltd. released the world's leading foldable modular building , and released a "flat and emergency dual-use" folding building with complete architectural elements that can be extended with one button, complete

facilities, green energy saving, comfortable and environmentally friendly, and can be occupied after 2 hours ; China Building Materials Equipment Group Co., Ltd. took the lead in releasing the world's first cement full oxygen combustion coupled carbon capture technology, In 2024, the world's first and largest production line in the cement industry with an annual capture capacity of 200,000 tons of carbon dioxide was built ; Anhui Conch Group Co., Ltd. launched the world's first zero-purchased electricity demonstration factory in the cement industry , and pioneered zero-purchased electricity, all-green electricity, and load balancing dispatching and control systems, realizing the efficient and stable use of green electricity ; Mona Lisa Group Co., Ltd. launched the world's first ceramic industry ammonia hydrogen zero-carbon combustion technology demonstration line , realizing the first application of ammonia hydrogen clean energy zero-carbon combustion technology in the industrial production line of building ceramics .



Figure 9: “Superior Products and Advanced Industry” Breakthrough New Technology And Product Launch Conference
Source: China Building Materials Federation

10. Triumph Technology Group produces the world's first 8.6-generation OLED glass substrate

On December 29, China News reported that the world's first 8.6-generation OLED glass substrate product independently developed and produced by China National Building Material Research Institute of Glass New Materials and Bengbu Zhongguang Optoelectronics, a subsidiary of Triumph Technology Group, was successfully rolled off the production line in Bengbu, Anhui. The project team independently developed a complete set of core technology equipment and produced the world's first 8.6-generation OLED ultra-thin float glass substrate with complete intellectual property rights, which is of great significance to leading the high-quality development of the new display industry.



Figure 10: The world's first 8.6-generation OLED glass substrate product was successfully launched

Source: Triumph Technology Group