IIT Indore Collaborates with RRCAT to Unlock the Future of Advanced Materials

Researchers at IIT Indore, in collaboration with Raja Ramanna Centre for Advanced Technology (RRCAT), have made a significant breakthrough in the synthesis of MAX phase and MXene materials, which are set to transform the field of advanced materials. Following the discovery of graphene, there has been a global focus on developing 2D materials like oxides, chalcogenides, and carbides. MXenes, a type of 2D carbide material derived from MAX phase, are layered structures similar to the folds of an accordion. These materials are known for their use in a wide range of applications, including lithium-ion batteries, supercapacitors, sensors, antennas, water purification, electromagnetic interference (EMI) shielding, metal crack healings, hydrogen generation and storage, and mechanical treatments.

MXenes have the potential to revolutionize industries such as defense, aerospace, energy, and biomedical sectors, thanks to their ability to control materials at the nanoscale. This research is financially supported by the Science Education Research Board (SERB) of the Department of Science & Technology (DST), India.

The team, of Prof. Rupesh S. Devan from IIT Indore and Dr. Ravindra Jangir from RRCAT, has developed a new method called the "Molten Salt Solid-State Reaction-Based Process" for synthesizing MAX phase, which is used to produce high-quality MXenes. This patented process, created in an Indian laboratory, allows for the production of pure MAX phase in ambient conditions, followed by a chemical process to create MXenes. This method marks a significant improvement over traditional high-temperature, energy-consuming methods, making the process more sustainable and cost-effective. With MXene prices currently exceeding ₹1,50,000 for just 500 mg, this new approach could drastically reduce production costs and expand the material's commercial viability.

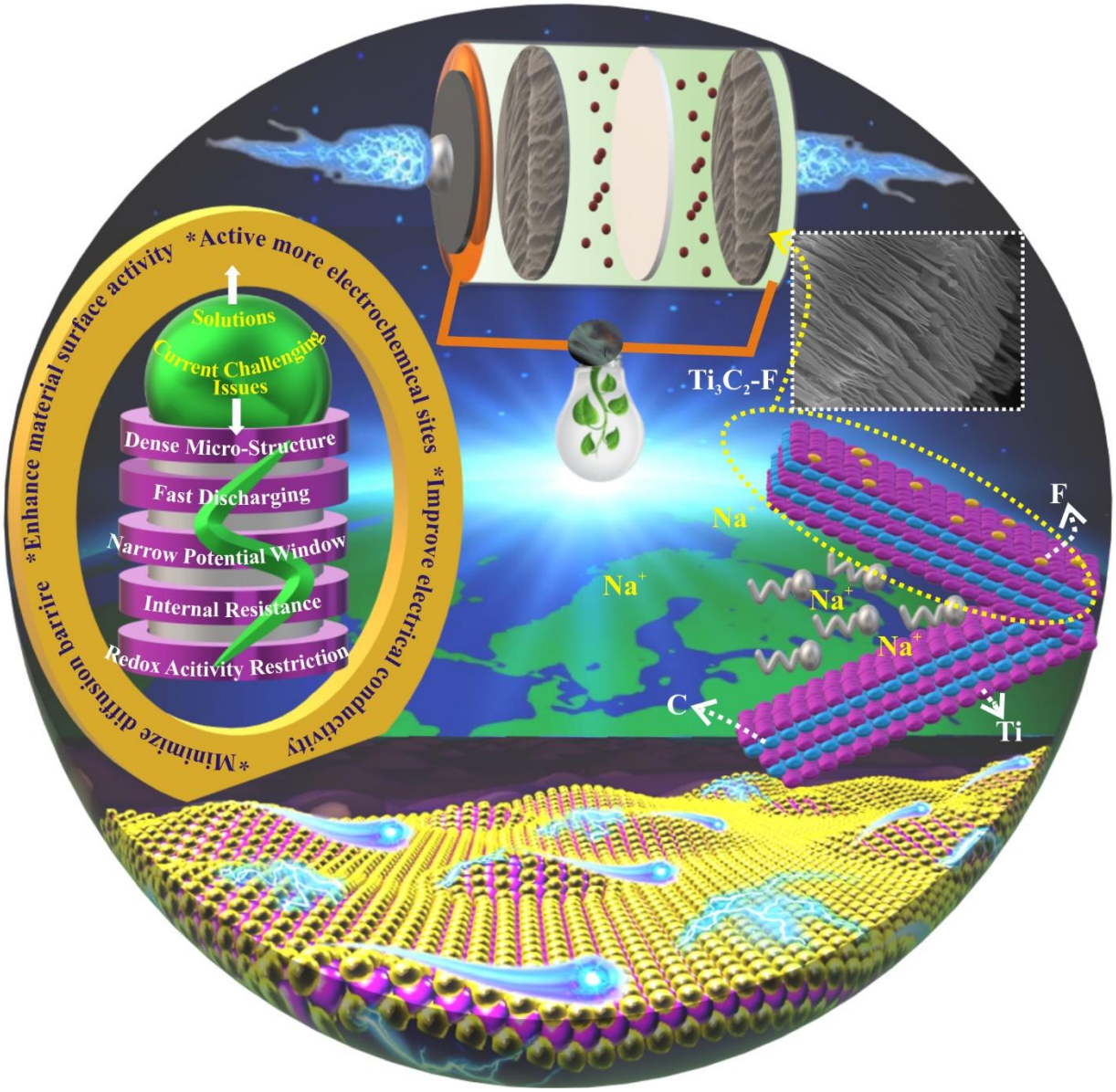
MXenes' superior performance characteristics make them ideal for energy storage, offering faster charging times and longer lifespans for batteries and supercapacitors. These features are essential for the development of electric vehicles and renewable energy systems. Additionally, MXenes are excellent candidates for hydrogen production and storage, contributing to global efforts towards sustainable energy solutions.

The affordability and efficiency of this new synthesis method could pave the way for MXenes to be used more widely in various industries. As the demand for high-performance materials grows, MXenes are expected to become more competitive in the global market, showcasing the capabilities of Indian researchers on a global scale.

Beyond energy storage and hydrogen production, MXenes have other promising applications, such as water purification. Their ability to filter contaminants makes them vital for addressing water scarcity issues. Additionally, MXenes are highly effective in shielding against electromagnetic interference, which is critical for protecting sensitive equipment in the defense and aerospace industries.

As this technology progresses towards commercial production, researchers have scaled up the process and exploring new applications in various sectors. The environmental benefits of this new synthesis method, including lower energy consumption and reduced waste, position MXenes as a sustainable option for the future of materials science.

This groundbreaking development from IIT Indore and RRCAT is not only a significant scientific achievement but also a major step toward creating sustainable and efficient materials for industries worldwide. The work of Prof. Devan, Dr. Jangir, and their team highlights the innovative spirit of Indian researchers and reinforces India's position as a leader in the development of advanced materials. As research on MXenes continues, we can expect even more exciting advancements, contributing to a sustainable future and global scientific progress.


*Active more electrochemical sites
*Improve electrical conductivity
*Minimize diffusion barrire
*Enhance material surface activity
Solutions
Current Challenges
Issues
Dense Micro-Structure
Fast Discharging
Narrow Potential Window
Internal Resistance
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