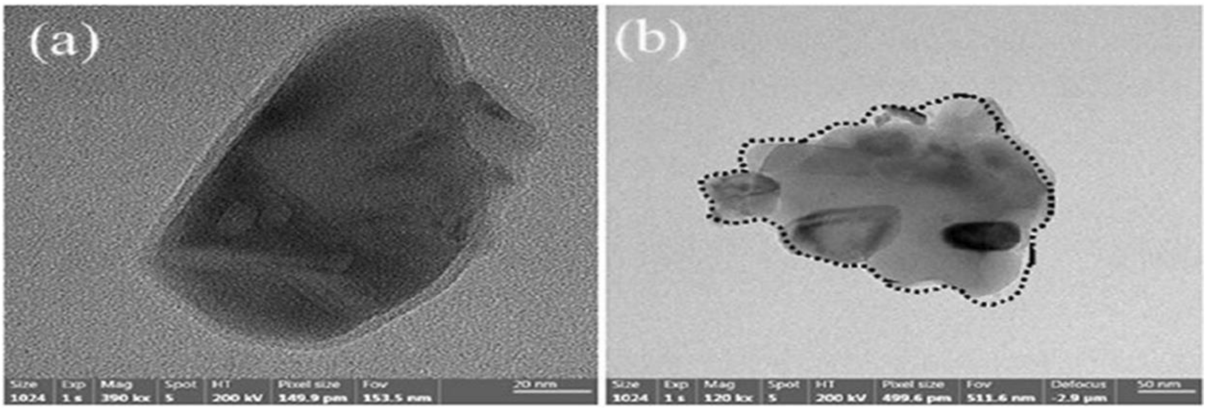
Unveiling the Synergy of Er_2O_3 and MXene for Efficient and Durable Energy Storage systems

Ambika M R[a]

[a]*Department of Physics, M S Ramaiah Institute of Technology, Bengaluru-560054, India*

**Corresponding author email ID:* ambikamr@msrit.edu



Abstract

In recent years, MXenes, a class of two-dimensional transition metal carbides and nitrides have emerged as highly promising materials, owing to their exceptional physicochemical attributes. These include intrinsic hydrophilicity, surface functional versatility and notable ion exchange capacity and their ability to form functional composites with a wide range of materials. Among these, the integration of MXenes with Erbium Oxide (Er_2O_3), a rare-earth metal oxide, offers an effective pathway to fine-tune their electrochemical properties for energy storage applications. Despite their potential, the synthesis of MXenes, particularly Ti_3C_2, remains a critical challenge. Once synthesized, these conductive materials can be further engineered into nanocomposites via hydrothermal techniques. In this work, Ti_3C_2 MXene and Er_2O_3-based composites were successfully fabricated and investigated for their structure and morphology using X-ray diffraction (XRD) and Field Emission Scanning Electron Microscopy (FESEM) techniques respectively, confirming effective composite formation. Chemical bonding and surface functionality were further examined through Fourier-Transform Infrared Spectroscopy (FTIR) and Raman analysis. The resulting nanocomposites exhibit remarkable specific capacitance, excellent cycling stability, and improved ion transport, underscoring their strong potential for next-generation energy storage applications (mention the application like hybrid cellphone chargers, smart devices like home tracking devices, solar-storage devices etc).