Tata Institute of Fundamental Research
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Webinar

High-Rate Redox Charge Storage Enabled by MXenes

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MXenes are an emerging large family of two-dimensional (2D) transition metal carbides, nitrides, and carbonitrides that were discovered at Drexel in 2011 and have become versatile materials due to a combination of hydrophilicity and metallic conductivity. Given their compositional diversity, tuneable surface chemistry, existence of various ordered structures and solid solutions, MXenes may well be the largest family of 2D materials known to date. The inherent surface terminations (-O, -F, -OH) of MXenes impart negative surface charges, key for stable MXene dispersions in water and organic solvents which enable solution processing to ease the design of electrode architectures. The available 2D gallery spaces for intercalation, accessible redox sites at the transition metal oxide-like surface, and metallic conductivity make MXenes promising as potential candidate materials for high rate (pseudo) capacitive energy storage applications. The ability of MXenes to intercalate a variety of cations while promoting fast charge transfer rates, expanding their widespread usage in a variety of electrochemical energy storage applications including high rate supercapacitors, hybrid metal-ion capacitors and beyond Li-ion batteries. Thanks to high electrical conductivity of titanium carbide MXene (beyond 15,000 S/cm), replacing metal current collectors in fabrication of microsupercapacitors and hybrid energy storage devices, potentially reducing the stack weight and volume of the devices.

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