Department of Materials Science and Engineering

MS Thesis Defense

31st March 2025; 10am to 12pm

Location: ECE Seminar Hall (B302)

https://drexel.zoom.us/j/85364144733

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Effect of CTAB Intercalation on Electrochemical Properties of $Ti_3C_2T_x$ MXene

Abstract:

The intercalation of cationic surfactants, like cetyltrimethylammonium bromide (CTAB), into two-dimensional (2D) materials, such as MXenes, has emerged as a pivotal strategy to modify their intrinsic properties, including electronic characteristics and surface charge. This method significantly broadens the application potential of MXenes in cutting-edge fields like electronics, energy storage, and catalysis. The process of CTAB intercalation facilitates the expansion of interlayers of MXenes, thereby offering a route to tailor their electrical conductivity and band structure through the selective insertion of ions or molecules. Such modifications allow for the tunability of hydrophobicity of the material by varying the concentration of the intercalant. Despite the benefits of CTAB pre-intercalation in enhancing the electrochemical performance of MXene-based electrodes, the underlying mechanisms, particularly the distinction between steric and kinetic effects of ion storage, remain insufficiently explored. The impact of varying the intercalants and their concentrations on MXene characteristics across diverse applications necessitates further investigation. Additionally, the long-term stability and reusability of CTAB intercalated MXenes under various environmental and operational conditions are crucial aspects that are yet to be fully understood. Addressing these knowledge gaps is essential for advancing MXene applications in fields, such as energy storage, ion separation, adsorption, and actuation.