ABSTRACT:

MXenes as Conductive 2D Materials for Nanoelectronics

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2D MXenes are promising materials for nanoelectronics because of their metallic electrical conductivity, solution processability, and chemical and structural tunability. Ti3C2Tx MXene films exhibit electrical conductivities exceeding 10,000 S/cm, with a breakdown current density of 1.2 × 108 A.cm−2. Beyond Ti3C2Tx, the MXene family has rapidly grown to over 100 synthesized compositions. In this talk, I will discuss how compositional design and defect engineering influence the electrical transport and stability of MXenes. I will present our recent studies on control of transition-metal chemistry, defect engineering through vacancies and substitutional defects, and compositionally complex MXenes. I will then discuss our recent discovery that thermally fusing MXene flakes through oxygen-bridged interfaces produces a new class of non-van der Waals layered ceramics with enhanced electrical conductivity while retaining their layered architectures stable up to 500 °C for potential use in high-temperature electronics.