Chemically Tunable 2D Layered Materials Through Atomic Intercalation

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Chemistries to reversibly intercalate and deintercalate zero-valent metal, semi-metal, and semiconductor atoms (Ag, Au, Bi, Co, Cr, Cu, Fe, Ge, In, Mn, Mo, Ni, Os, Pd, Pt, Rh, Ru, Sb, Sn, W) into almost any two-dimensional layered material including chalcogens, halides, oxides, and hexagonal-BN will be presented. The chemical nature of the intercalant allows for significant concentrations of guest atoms. These chemistries can be used to intercalate more than one element into a host accessing interlayer intercalation alloys. We are able to achieve chemical tunability of the electronic bandgap, color, structure, phase transitions, mechanical properties, and acoustic phonons of 2D layered materials including Si2Te3 and α-MoO3. Further, I will show how these topochemical strategies can be adapted to synthesize novel heterostructures.