Chemically Tunable 2D Materials

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Abstract: Two-dimensional (2D) materials, such as layered chalcogenides, graphene, and oxides, are an exciting new class of materials with extraordinary physical and chemical behaviors. These high-performance materials have the potential to enable an entire fleet of new technological applications ranging from electronics to photonics. To realize this potential requires (i) the synthesis of novel, high-quality 2D materials, (ii) a broad spectrum of chemical modification techniques, and (iii) a thorough understanding of how these modifications control the material physics

In this presentation, I will show new synthetic growth methods to generate 2D layered materials such as Si2Te3. I will present a novel chemical method to reversibly intercalate and deintercalate high concentrations of multiple, zero-valent atoms into 2D materials. The zero-valent nature of the intercalant species allows for high-density intercalation of up to 60 atomic percent of metal atoms (Ag, Au, Co, Cu, Fe, In, Ni, and Sn) effectively doubling the number of atoms of the material. This chemistry achieves unique physics including Pokrovsky-Talapov transitions, sliding charge density waves, and chemically tunable acoustic phonons as detected through Brillouin light scattering.