

# Metals at the Atomic Limit

**Joshua A. Robinson**

Materials Science and Engineering, Center for 2D and Layered Materials, NSF 2D Crystal Consortium, NSF Center for Atomically Thin Multifunctional Coatings;  
*The Pennsylvania State University; University Park, PA, USA*

The last decade has seen an exponential growth in the science and technology of two-dimensional materials. Beyond graphene, there is a huge variety of layered materials that range in properties from insulating to superconducting that can be grown over large scales for a variety of electronic devices and quantum technologies, such as topological quantum computing, quantum sensing, and neuromorphic computing. In this talk I will discuss our pioneering work in confinement heteroepitaxy (CHet) that enables the creation of 2D forms of 3D materials (e.g. 2D-Ga, In, Sn) and *decouples* the growth of the metals from other 2D layers, thereby enabling a new platform for creating artificial quantum lattices (AQLs) with atomically sharp interfaces and designed properties. As a specific example, we synthesize plasmonic layers that exhibit >2000x improvement in nonlinear optical properties, and 2D-superconductors combined with topological insulators as the building block of next generation “2D” topological superconductors. Confinement heteroepitaxy opens up avenues for enabling a virtual “legoland” of hybrid quantum materials.