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Exploring Metals at the Atomic Limit

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 recent breakthroughs in the realization of unique 2D forms of traditional 3D metals. I will introduce a novel synthesis method, dubbed confinement heteroepitaxy (CHet), that utilizes graphene to enable the creation of atomically thin metals, enabling a new platform for creating artificial quantum lattices with atomically sharp interfaces and designed properties. By shrinking these traditional metals to atomically thin structures, we find that their properties are quite different than their bulk counterparts, lending themselves to unique quantum and optical applications not possible before.

References

[1] Atomically thin half-van der Waals metals enabled by confinement heteroepitaxy; Nature materials 19 (6), 637-643, 2020
[2] Unexpected Near-Infrared to Visible Nonlinear Optical Properties from 2-D Polar Metals. Nano Lett. 20, 11, 8312–8318, 2020
[3] Tunable Two-Dimensional Group-III Metal Alloys, Advanced Materials, 33, 44 2104265 2021
[4] Light–Matter Interaction in Quantum Confined 2D Polar Metals, Advanced Functional Materials; 31,4, 2005977, 2021
[5] Atomic-Level Structure Determines Electron–Phonon Scattering Rates in 2-D Polar Metal Heterostructures, ACS nano, 15, 11, 17780-17789, 2021
[6] Epitaxial graphene/silicon carbide intercalation: a minireview on graphene modulation and unique 2D materials, Nanoscale 11 (33), 15440-15447, 2019