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Van der Waals Epitaxy of Functional Oxide Heterostructures

YING-HAO CHU, National Chiao Tung University

In the diligent pursuit of low-power consumption, multifunctional, and environmentally friendly electronics, more sophisticated requirements on functional materials are on demand. Recently, the discovery of 2D layered materials has created a revolution to this field. Pioneered by graphene, these new 2D materials exhibit abundant unusual physical phenomena that is undiscovered in bulk forms. These materials are characterized with their layer form and almost pure 2D electronic behavior. The confinement of charge and heat transport at such ultrathin planes offers possibilities to overcome the bottleneck of present device development in thickness limitation, and thus push the technologies into next generation. Van der Waals epitaxy, an epitaxial growth method to combine 2D and 3D materials, is one of current reliable manufacturing processes to fabricate 2D materials by growing these 2D materials epitaxially on 3D materials. Then, transferring the 2D materials to the substrates for practical applications. In the mean time, van der Waals epitaxy has also been used to create free-standing 3D materials by growing 3D materials on 2D materials and then removing them from 2D materials since the interfacial boding between 2D and 3D materials should be weak van der Waals bonds. In this study, we intend to take the same concept, but to integrate a family of functional materials in order to open new avenue to flexible electronics. Due to the interplay of lattice, charge, orbital, and spin degrees of freedom, correlated electrons in oxides generate a rich spectrum of competing phases and physical properties. Recently, lots of studies have suggested that oxide heterostructures provide a powerful route to create and manipulate the degrees of freedom and offer new possibilities for next generation devices, thus create a new playground for researchers to investigate novel physics and the emergence of fascinating states of condensed matter. In this talk, we use a 2D layered material as the substrate. And we take several oxides as examples to demonstrate a pathway to integrate 3D functional oxides on 2D layered materials.