TST-003

Two-dimensional heterostructures for All-2D Electronics

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Among various two-dimensional (2D) materials, 2D semiconductors and insulators have attracted a great deal of interest from nanoscience community beyond graphene, due to their attractive and unique properties. Such excellent characteristics have triggered highly active researches on 2D materials, such as hexagonal boron nitride (hBN), molybdenum disulfide (MoS2), and tungsten diselenide (WSe2). New physics observed in 2D semiconductors allow for development of new-concept devices. Especially, these emerging 2D materials are promising candidates for flexible and transparent electronics. Recently, van der Waals heterostructures (vdWH) have been achieved by putting these 2D materials onto another, in the similar way to build Lego blocks. This enables us to investigate intrinsic physical properties of atomically-sharp heterostructure interfaces and fabricate high performance optoelectronic devices for advanced applications. In this talk, fundamental properties of various 2D materials will be introduced, including growth technique and influence of defects on properties of 2D materials. We also fabricate high performance electronic/optoelectronic devices of vdWH, such as transistors, memories, and solar cells. The device platform based on van der Waals heterostructures show huge improvement of devices performance, high stability and transparency/flexibility due to unique properties of 2D materials and ultra-sharp heterointerfaces. Our work paves a new way toward future advanced electronics based on 2D materials.

Keywords: 2D materials, graphene, MoS2, hBN, van der Waals