2D Transition Metal Dichalcogenide Monolayers and Their Heterostructures

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Venue: w563, Physics building, Peking University

地点: 北京大学物理楼，西563会议室

Abstract

Our recent demonstration in vapor phase growth of TMD monolayers such as MoS_2 and WSe_2 has stimulated the research in growth and applications (1). The growth mechanism and the orientation control of the 2D flakes will be first discussed. These 2D monolayer building blocks can be used to form *p-n* junctions. For example, the heterostructures of 2D materials formed by vertical stacking have been realized via transfer of their exfoliated flakes, where their electronic structures are dominated by the stacking orientation and strength of interlayer coupling(2). Another very attractive structure is the lateral heterojunction, where we have demonstrated that the atomically sharp p-n junction exhibits diode properties and a large strain exhibits at the junction region which offers tunability in electronic structures (3). In addition to the symmetry 2D materials, we have also developed a method that can precisely manipulate arrangement of chalcogenide atoms (S and Se) along the vertical direction of TMD. This new strategy allows us to fabricate a MoSSe Janus structure, where the transition metals are sandwiched by selenium at upmost and sulfur at bottom. Such a Janus 2D monolayer exhibits piezoelectric responses and optical dipole along out-of-plane direction (4).

(1) Synthesis of Large-Area MoS_2 Atomic Layers with Chemical Vapor Deposition ***Adv. Mater.*** 24, 2320 (2012)
(2) Determination of band alignment in the single layer MoS_2/WSe_2 heterojunction. ***Nature Comm.*** 6, 7666 (2015)
(3) Epitaxial growth of a monolayer WSe2-MoS2 lateral p-n junction with an atomically sharpinterface. ***Science*** 349, 524 (2015).
(4) Janus monolayers of transition metal dichalcogenides. ***Nature Nanotech.*** (2017) doi:10.1038/nnano.2017.100

About the Speaker

He has published more than 250 SCI journal articles.
Overall citation >17200 and h-index: 63

Education

2006 Ph.D. in Condensed Matter Physics: Oxford University,
1996 MSc in Chemistry: National Taiwan University, Taipei, Taiwan, 1994-1996
1994 B.S. in Department of Chemistry

Academic Careers

2016- Full Professor, Materials Science and Engineering, KAUST
2014-2016 Associate Professor, Materials Science and Engineering, KAUST

Awards and Recognition

2017 Universal Scientific Education and Research Network (USERN) advisory board member and 1% top scientist
2013 Wu Ta Yu Awards (NSC, Taiwan)
2013 Asian Rising Star (15th Asian Chemical Congress, Singapore)