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Photon and Energy Conversion through Atomically Thin Semiconductor Heterojunctions

The recent advent of semiconducting transition metal dichalcogenides (TMDCs) with exceptional optical properties, combined with the ability to build artificial van der Waals heterostructures, enables the realization of unique atomically thin heterojunctions for applications in photon (or energy) conversion as well as fundamental studies at an ultimate thickness limit. In this talk, I will first discuss photon coversion processes in vertically-stacked *p*-*n* junctions (WSe_2/MoS_2) [1] and monolithically-fabricated oxide/semiconductor heterojunctions (WO_3/WSe_2), which exhibited highly efficient and fast conversion. In addition, using such an ultrafast charge transfer at the interface, the atomically thin type-II heterojuction can be utilized as a catalyst for photoelectrochemical (PEC) water splitting. As the second subject of the talk, I will present the *in-situ* characterizaiton of enhaced PEC performances of the MoS_2/WS_2 heterojunciton catalyst for hydrogen evolution reaction. Lastly, I will further present the wafer-scale growth of monolayer TMDCs and their epitaxial heterojunction bilayers using metal-organic chemical vapor deposition (MOCVD) for future practical applications.

References

[1] C.-H. Lee, et al. “Atomically thin *p*-*n* Junctions with van der Waals Heterointerfaces” Nature Nanotechnology 9, 676-681, 2014.