**Photon and Energy Conversion through Atomically Thin Semiconductor Heterojunctions**

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The recent advent of semiconducting transition metal dichalcogenides with exceptional optical properties, combined with the ability to build artificial van der Waals (vdW) 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 conversion processes in vertically-stacked vdW p-n junctions (WSe2/MoS2) [1], 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 MoS2/WS2 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.