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Charge transport and optoelectronic process in an atomically thin p-n junction CHUL-HO LEE, Physics, Columbia Univ., GWAN HYUNG LEE, Mechanical Eng., Columbia Univ., AREND VAN DER ZANDE, Energy Frontier Research Center, Columbia Univ., WENCHAO CHEN, Electrical & Computer Eng., Univ. of Florida, YILEI LI, MINYONG HAN, Physics, Columbia Univ., XU CUI, GHIDEWON ARAFFE, Mechanical Eng., Columbia Univ., COLIN NUCKOLLS, Chemistry, Columbia Univ., TONY F. HEINZ, Physics, Columbia Univ., JING GUO, Electrical & Computer Eng., Univ. of Florida, JAMES HONE, Mechanical Eng., Columbia Univ., PHILIP KIM, Physics, Columbia Univ. — Heterostructures based on atomically thin van der Waals materials provide an unprecedented opportunity in new materials design. In particular, the ability to assemble two-dimensional (2D) materials into artificial heterostructures with atomically sharp interfaces, combined with recent rediscoveries of transition metal dichalcogenides as an atomically thin semiconductor, enables to build the unique 2D semiconductor heterojunction for fundamental studies as well as device applications. In this talk, we present the electronic and optoelectronic processes in an atomically thin p-n junction consisting of vertically stacked WSe_2 and MoS_2 monolayers. Unlike conventional p-n junctions, tunneling-mediated recombination governs the overall charge transport, and gate-tunable photovoltaic response is driven by charge transfer at the atomically sharp interface with large band offsets. Furthermore, the fully vdW heterostructured vertical p-n junctions with graphene electrodes will be discussed.

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