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Super-ideal diodes at the Schottky-Mott limit in gated graphene-WSe_2 heterojunctions

Metal-semiconductor interfaces, known as Schottky junctions, have long been hindered by defects and impurities. Such imperfections dominate the electrical characteristics of the junction by pinning the metal Fermi energy. We report measurements on a boron nitride encapsulated graphene-tungsten diselenide (WSe_2) Schottky junction which exhibits ideal diode characteristics and a complete lack of Fermi-level pinning. The Schottky barrier height of the device is rigidly tuned by electrostatic gating of the WSe_2, enabling experimental verification of the Schottky-Mott limit in a single device. Utilizing this exceptional gate control, we realize a "super-ideal" gated-Schottky diode which surpasses the ideal diode limit. Our results provide a pathway for defect-free electrical contact to two-dimensional semiconductors and open up possibilities for circuits with efficient switching characteristics and higher efficiency optoelectronic devices.

Figures

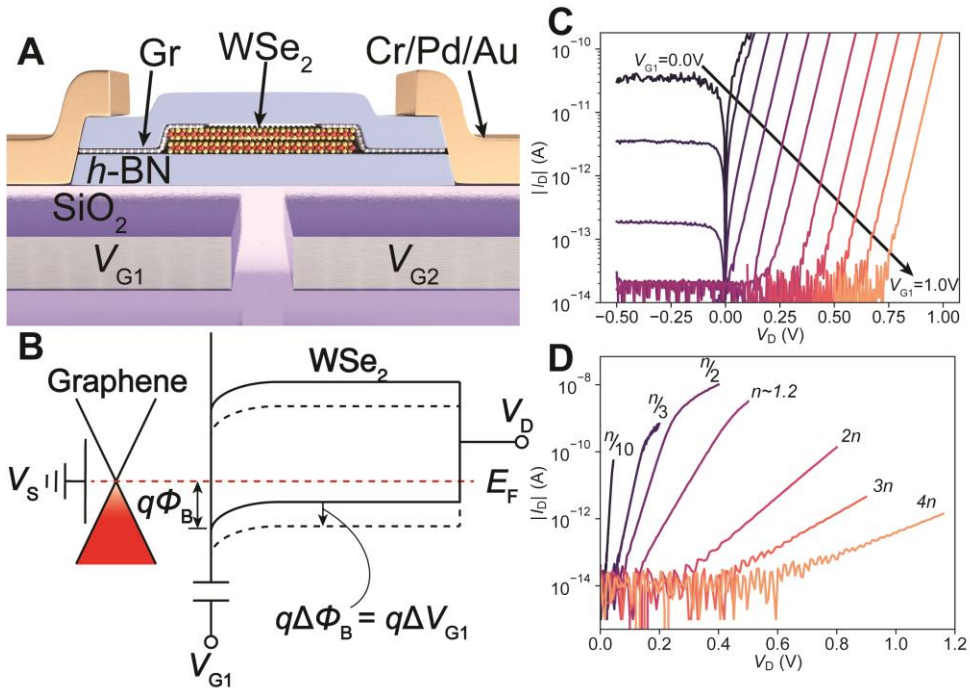

Figure 1: (A) Schematic of our device. **(B)** Band diagram of gated Gr-WSe_2 junction. **(C)** Gate tunable Schottky diode I-V characteristic for V_{G2}=-10V and varying V_{G1}. **(D)** Tunable ideality factor beating n = 1 with simultaneous sweeping of V_{G1} and V_D.