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Invited Speaker

Ionic Gating of 2D Semiconductors

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Abstract:

Ionic gating exploits electrolytes to control electrostatically the properties of semiconductors, in transistor devices with very large gate capacitance, in excess of 50 $\mu F/cm^2$ (three orders of magnitude larger than the capacitance of a commonly used, 300 nm thick SiO_2 gate dielectric). Such a large capacitance allows charge densities up to 5 10^{14} cm^{-2} to be accumulated at the surface of different semiconductors, and causes new phenomena to appear, among which gate-induced superconductivity is possibly the best-known example. As the level of control and understanding of ionic gating continues to improve, new applications of ionic gated devices emerge. Here I will discuss two aspects. First, I will show how the very large gate capacitance of ionic gated devices allows quantitative energy spectroscopy of band edges in 2D semiconductors, allowing precise measurements of band gaps and band alignment. Second, I will discuss double-gated ionic devices allowing extremely large values of electric field to be applied perpendicularly to atomically thin semiconducting layers, so strong to enable band gaps as large as 1.5 eV to be fully quenched. I will illustrate this result with systematic measurements performed on few layer WSe_2 double gated device, in which we succeeded in quenching the gap of tri-layer and thicker WSe_2 crystals.