Highlights

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Hysteresis in the transfer characteristics of MoS_2 transistors

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Molybdenum disulfide (MoS_2) has recently become one of the most popular semiconductors from the family of the transition metal dichalcogenides. The MoS_2 bandgap can be controlled by the number of layers: Bulk MoS_2 has an indirect bandgap of 1.2 eV while monolayer MoS_2 has a direct bandgap of 1.8 eV. The large bandgap, combined with mechanical flexibility, makes MoS_2 suitable as channel in field effect transistors (FETs) for logic applications.
We investigate the origin of the hysteresis observed in the transfer characteristics of back-gated field effect transistors with an exfoliated MoS_2 channel. We find that the hysteresis is strongly enhanced by increasing either gate voltage, pressure, temperature or light intensity. Our measurements reveal a step-like behavior of the hysteresis around room temperature, which we explain as water-facilitated charge trapping at the MoS_2/SiO_2 interface. We conclude that intrinsic defects in MoS_2, such as S vacancies, which result in effective positive charge trapping, play an important role, besides H_2O and O_2 adsorbates on the unpassivated device surface. We show that the bistability associated to the hysteresis can be exploited in memory devices.

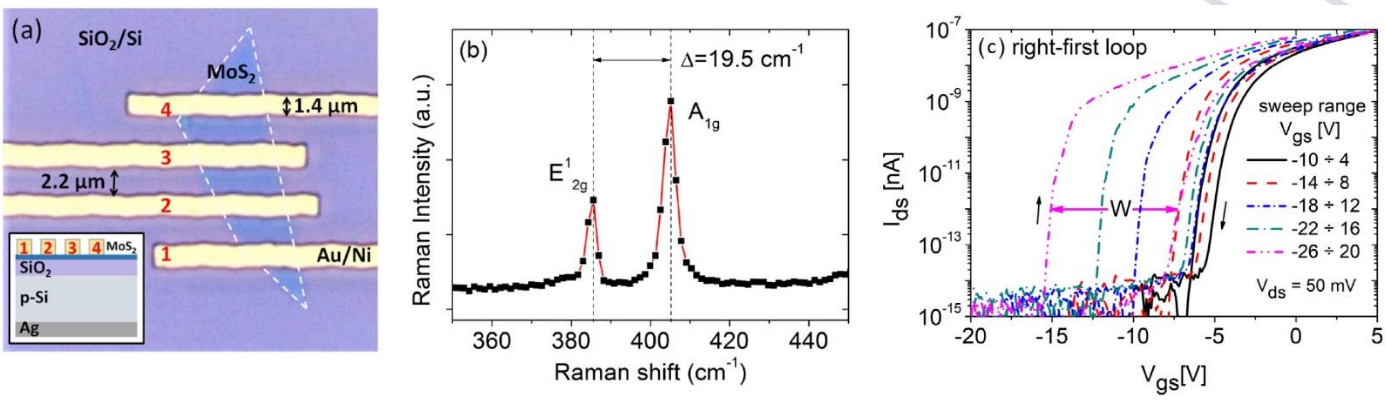

Figure 1. (a) Optical image of a monolayer MoS_2 flake (highlighted by dashed white lines) contacted with Ni/Au leads; the inset shows the schematic cross-section of the back-gated FET. (b) Raman spectrum of the MoS_2 flake. (c) Transfer characteristics of the MoS_2 transistor for the back-gate voltage, Vgs , in loops of different amplitudes but with fixed
steps (Vgs = 0.1 V).