2D MoS_2 CAPACITORS AND TRANSISTORS STUDIED BY EXCITONIC REFLECTION MICROSCOPY

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Inverted reflection microscopy is a powerful tool to study nanomaterials undergoing *in situ* processes. Its configuration is highly compatible to work with solvents, and the use of metallic anti-reflection coatings can enhance sensitivity to changes in optical path length (OPL), in addition to serving as an electrode. We recently demonstrated some of its assets for the high-contrast observation of graphene oxide and its chemical modifications [1] as well as for the *in situ* study of ultrathin molecular film growth [1,2].

In the present work, we show how reflectance imaging can be used to study semiconductor devices of 2-dimensional (2D) MoS_2, a transition metal dichalcogenide (TMD) crystal, synthesized by chemical vapor deposition (CVD). As explained in [3], 2D TMDs exhibit gate-tunable optical properties (n,κ) near the exciton energies. Therefore, at appropriate wavelengths a reflectance change is correlated with the local charge density profile of a TMD device [4,5]. Based on this principle, we study MoS_2 device operation *in situ* for both capacitors and field-effect transistors (FET), in wide-field mode and with high throughput. In Figure 1a, a network of interconnected MoS_2 domains is capacitively charged, and reflectance change images are acquired as a function of time. In addition to local charge inhomogeneity imaging within each individual MoS_2 domain, this type of experiment informs on the domain-to-domain contact resistances through the RC charging delay they induce.

In Figure 1b, a FET example is shown, where an asymmetric drain-source charge profile is observed when switching the device polarity. In the proposed talk, we will show how such a technique opens the door to measuring high-throughput *in operando* device physics parameters of nanomaterial electronic systems, using readily accessible optical equipment.

References

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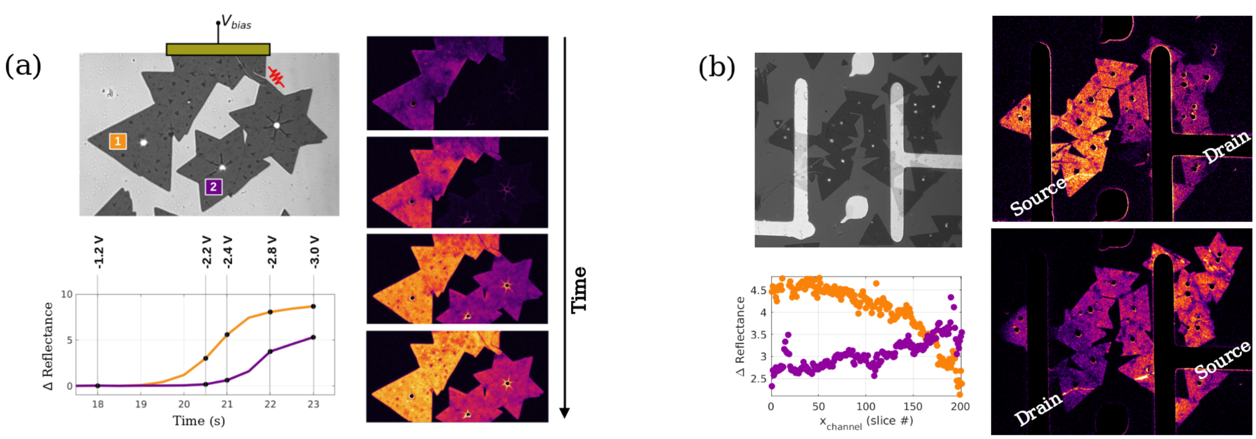

Figure 1: (a) Charging dynamics of MoS_2 capacitor network revealed by reflectance change. (b) Charge density profile of MoS_2 FET revealed by reflectance change, for different polarity.

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