MoS_2 Field-Effect Transistors: Transport Properties, Electron Irradiation and Field Emission

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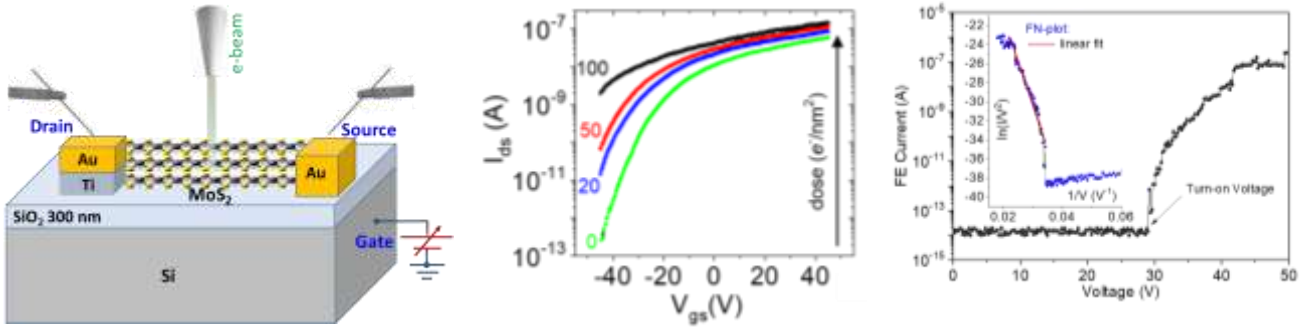
We perform a detailed electrical characterization of CVD-synthesized few-layer MoS_2-based field-effect transistors (FETs), with Ti/Au electrodes, inside a scanning electron microscope (SEM), in order to study the effects of low-energy electron-beam irradiation (up to 10 keV) on the transport properties of the device.
We report an increase of the carrier mobility and a negative shift of the threshold voltage for successive low-energy irradiations that is explained in terms of positive charge trapped in the SiO_2 gate dielectric, during the irradiation [1]. The transistor channel current is increased up to three orders of magnitudes after the exposure to an irradiation dose of 100 e^-/nm^2.
Moreover, profiting of the measurement setup with nanomanipulated metallic probe-tips inside the SEM chamber, we also perform a complete characterization of the field emission properties of the MoS_2 nanosheets. Indeed, the sharp edges and high aspect ratio of the nanosheets favour the electron emission, making this material suitable to realize field emission cathodes [1-3].
We report that a field emission current can be extracted from the MoS_2 nanosheets by the application of an electric field as small as 20 V/μm, when the tip anode is placed at 1.5 μm from the emitting surface. In this configuration, we also estimate a field enhancement factor of about 500.



(a) (b) (c)

Figure 1: (a) Schematic of the MoS_2 FET under e-beam irradiation. (b) transfer characteristics I_{ds}-V_{gs} measured at V_{ds} = 1.6 V for different electron beam irradiation doses. (c) Field emission characterization of MoS_2 flake. I–V curve measured at cathode–anode separation d = 300 nm. Left inset: FN-plot of the experimental data. Red line is the linear fit.

REFERENCES

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