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Transition metal dichalcogenide monolayers as gate controlled field emitters

Monolayers of molybdenum disulfide (MoS_2) and tungsten diselenide (WSe_2) have been synthetized by chemical-vapour deposition on a SiO_2/Si substrate. They were initially contacted to realize back-gated field-effect transistors, both showing n-type conduction under high-vacuum conditions. The n-type conduction enables field emission (FE), i.e. the extraction of electrons by quantum tunneling under the application of a high electric field. Local field emission measurements from the edges of the monolayers have been performed inside a scanning electron microscope (SEM) by using a nanomanipulated tip-shaped anode [1,2]. We demonstrate a turn-on field of the order of 100 V μm−1 and a good time stability of the emitted current for both materials. Finally, we show that the field emission current can be modulated by the back-gate voltage, opening the way for the development of a field-emission vertical transistor.

References

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[2] Antonio Di Bartolomeo, Francesca Urban, Maurizio Passacantando, Niall McEvoy, Lisanne Peters, Laura Iemmo, Giuseppe Luongo, Francesco Romeo and Filippo Giubileo, Nanoscale, 11 (2019) 1538

Figures

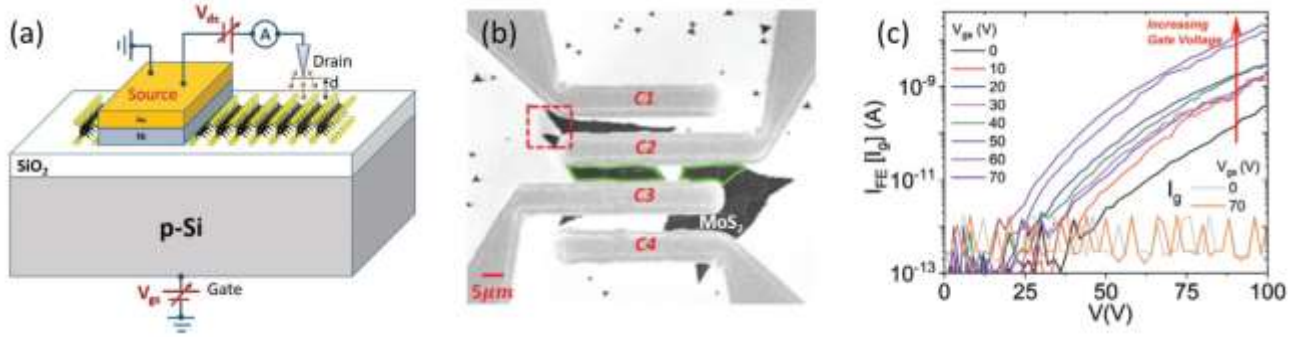

Figure 1: (a) Layout of a back-gate FE transistor with a TMD monolayer channel over a SiO_2/Si substrate. (b) SEM images of the MoS_2 device. The red dashed square highlights the part of the flake used for field emission measurements. (c) Field emission current measured at d = 200 nm for increasing gate voltage.