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Electronic transport and photoresponse of single- and few-layer MoS_2 vertical devices

We control electronic transport of vertical metal-atomically thin MoS_2-metal structures generating mechanical strain with the tip of a conductive atomic force microscope [1].
The structures show rectifying current-voltage (I-V) characteristics, with rectification ratios strongly dependent on the applied load. To understand these results, we compare the experimental I-Vs with a double Schottky barrier model, which is in good agreement with our experimental results and allows us to extract quantitative information about the electronic properties of the tip/MoS_2/metal structures and their dependence on the applied load. Finally, we test the stability of the studied structures using them as mechanically tunable current rectifiers.

Additionally, we study the photoresponse of vertical MoS_2 devices [2] using monochromatic illumination in the visible and near infrared range (Figure 2). We observe enhanced responsivity at the energies of the A and B excitons of MoS_2, while the responsivity drops sharply below de energy of the optical gap (1.8 eV).
By using a pulsed light source (pulse duration 1 ns) we observe photocurrent switching times in the range of one microsecond as well as high external quantum efficiency.

References

[1] J. Quereda *et al. 2D Materials* **4**, 021006 (2017).

[2] D. Maeso *et al. To be submitted* (2017).

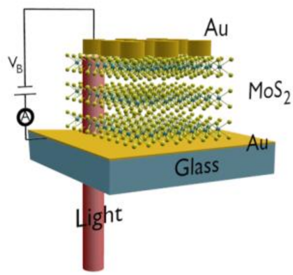

Figure 1: Schematic of vertical metal-2D semiconductor-metal devices obtained by sandwiching a few layer MoS_2 crystal between metallic electrodes.

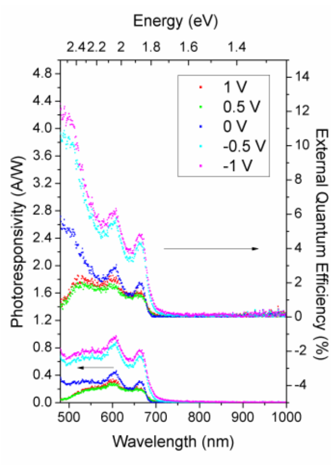

Figure 2: Wavelength dependent photoresponse and external quantum efficiency of the metal-MoS_2-metal devices for different biasing voltages.