# Strain engineering of Schottky barriers in single and few-layer $MoS_2$ vertical devices.

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Two-dimensional transition metal dichalcogenides have demonstrated a huge potential for the development of novel electronic devices. Among them, atomically thin $MoS_2$ raises special interest due to its relatively high carrier mobility and intrinsic 1.8 eV bandgap [1, 2]. Further, it has been recently demonstrated that the band structure of atomically thin $MoS_2$ crystals can be modified applying uniaxial or biaxial strain [3], enhancing even more their technological possibilities.
In this work we study experimentally the electron transport through vertical metal/atomically thin $MoS_2$/metal junctions, using a conductive AFM tip to contact single and few-layer $MoS_2$ crystals deposited onto a metallic substrate. Remarkably, even when the $MoS_2$ crystal is just one layer thick, two metal-semiconductor barriers are formed at the tip/$MoS_2$ and $MoS_2$/substrate interfaces. As a consequence, the structure shows a strong rectifying I-V characteristic. Furthermore, the rectification ratio of the I-V characteristic can be modified by applying mechanical pressure to the $MoS_2$ crystal with the AFM tip.
To further demonstrate the studied devices, we use them to rectify a periodic voltage, controlling the rectification ratio through the mechanical pressure applied with the AFM tip.

References

[1] Radisavljevic, B., et al., Nature nanotechnology, 2011. 6(3): p. 147-150.
[2] Krasnozhon, D., et al., Nano letters, 2014. 14(10): p. 5905-5911.
[3] Castellanos-Gomez, A., et al., Nano letters, 2013. 13(11): p. 5361-5366.

Figures

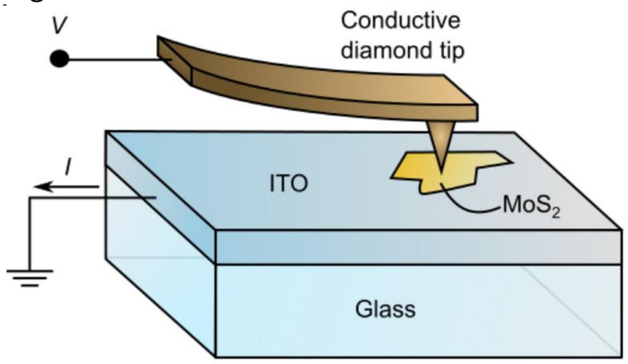


**Figure 1:** Schematic of the experimental setup: The semiconducting $MoS_2$ flake is sandwiched between a conductive ITO substrate and a metallic AFM tip. Two Schottky barriers are formed at the tip/$MoS_2$ and $MoS_2$/ITO interfaces.

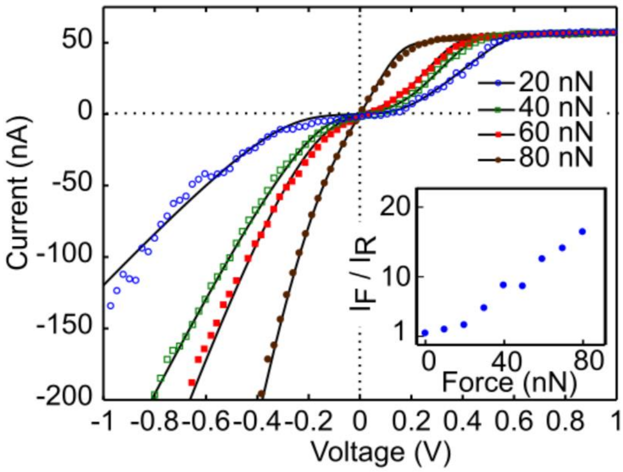


**Figure 2:** Measured I-V characteristics of an atomically thin $MoS_2$ flake under four different tip-flake contact forces. Inset: Force-dependent rectification ratio measured at ± 1V.