Valley current polarization and disorder probing in gated MoS_2 nanoribbons

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The growing interest in single-layer transition metal dichalcogenides is driven mostly by their promising applications in novel electronics that exploits spin and valley properties of charge carriers [1]. By the means of tight-binding [2] transport calculation we investigate the valley properties of a single-layer MoS_2 nanoribbon. We characterize the dispersion relation of the ribbon and explain valley polarization of the current carrying modes that belong to K, K', and Q valleys. We show that due to band mixing in a side-gated ribbon a valley polarization of the current can be achieved. Finally we explain how the current flowing through a nanoribbon is affected by disorder and how the disorder itself can be mapped out by Scanning Gate Microscopy.

References

[1] K. F. Mak, K. L. McGill, J. Park, P. L. McEuen, Science 344, 1489 (2014).
[2] E. Cappelluti, R. Roldán, J. A. Silva-Guillén, P. Ordejón, and F. Guinea, Phys. Rev. B 88, 075409 (2013).

Figures

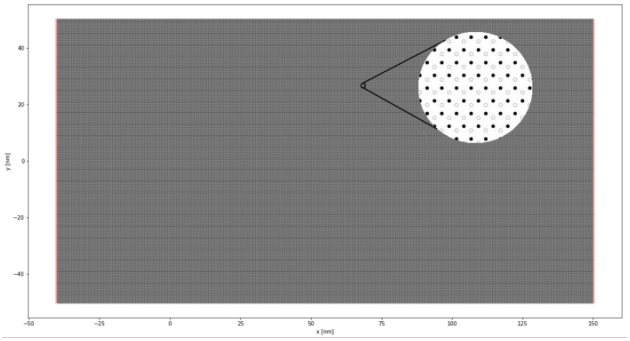

Figure 1: Tight binding model of a MoS_2 zigzag nanoribbon.

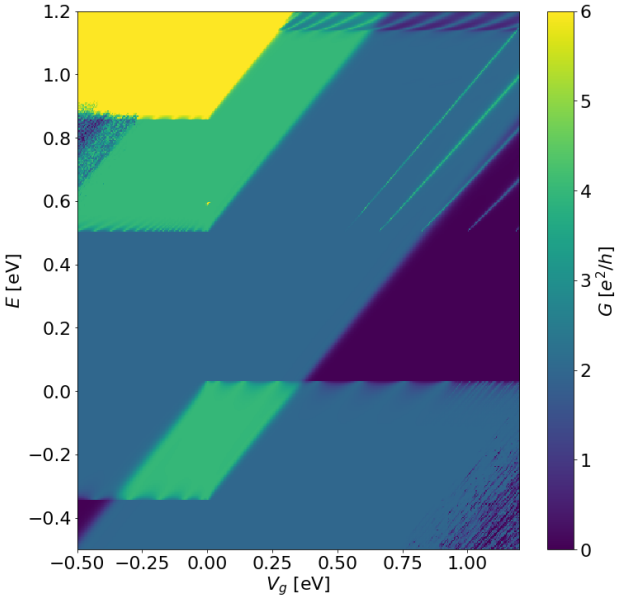

Figure 2: Conductance map of a locally gated nanoribbon.