Contacting single-molecule magnets with graphene-based electrodes

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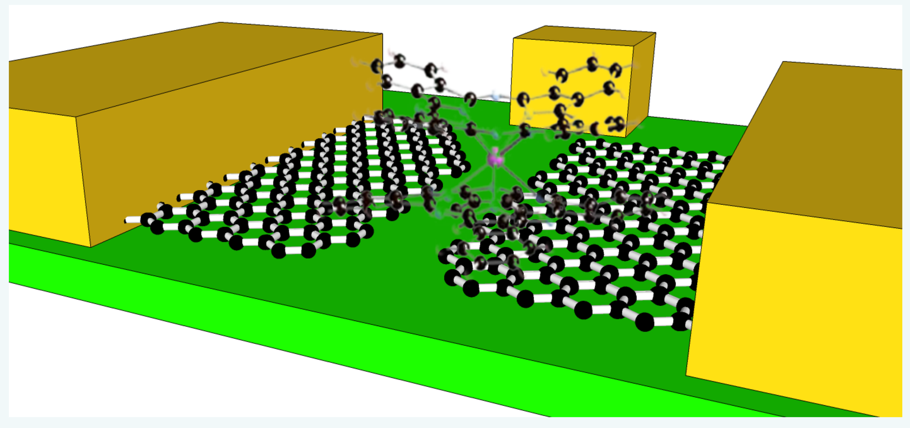
Thanks to N. Mishra, C. Coletti (IIT Pisa, Italy), P. Pingue and F. Carillo (Scuola Normale Superiore di Pisa, Italy) for assistance in sample fabrication

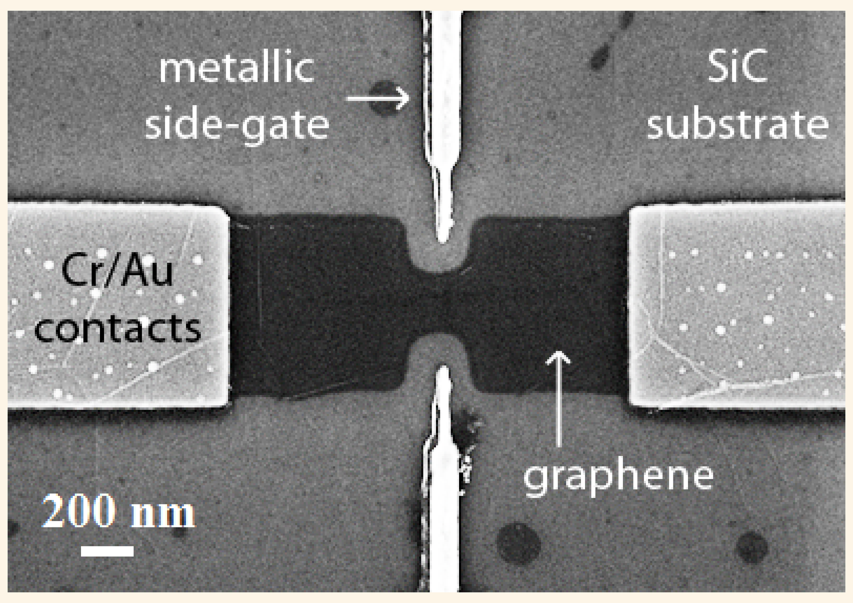
Abstract. Graphene is considered a promising material for the fabrication of electrodes for single-molecule devices, since it is stable up to high temperatures and its planar geometry allows for the anchoring of a wide variety of different molecules. Here, we studied three-terminal devices in which a single-molecule magnet ($TbPc_2$) is embedded between two nm-spaced few-layer graphene electrodes obtained by electroburning.



1. Device fabrication

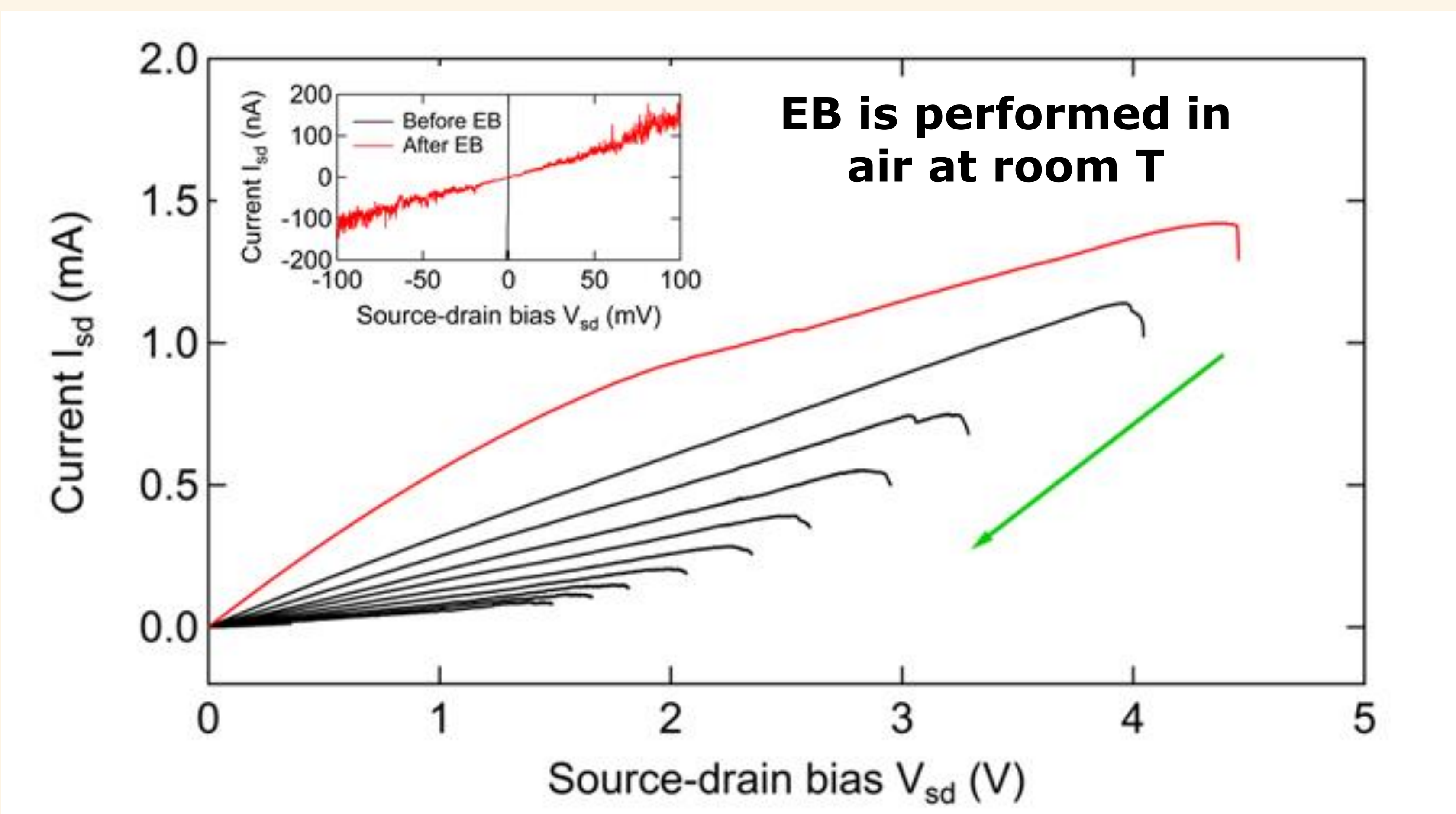
Turbostratic graphene is grown on the C-face of a SiC wafer.

RIE and EBL are used to pattern graphene in the desired geometry and to fabricate the electrical contacts[1].



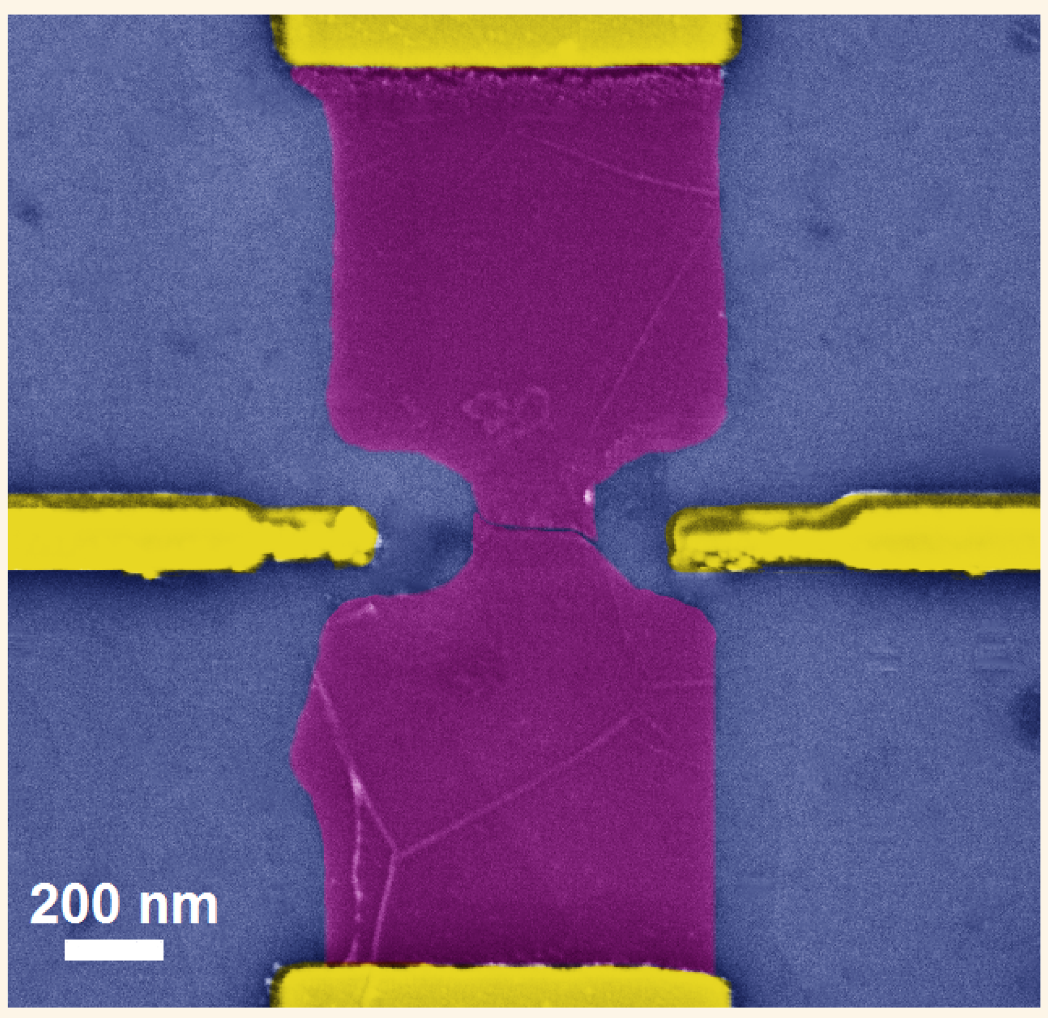
2. Electroburning

The presence of a fast **feedback loop**[2] avoids the abrupt breaking of the graphene junction.



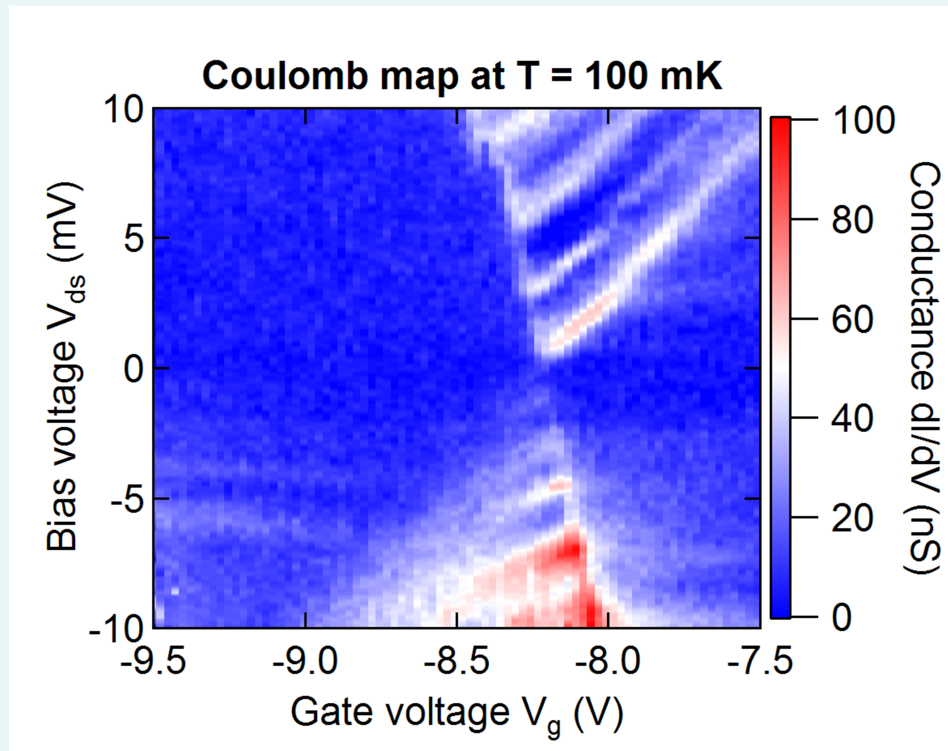
Nearly 90% of the junctions can be controllably led to a low-bias resistance between 100 kΩ and 3 MΩ.

Subsequent cool down at low T completes the opening of the nanogaps.



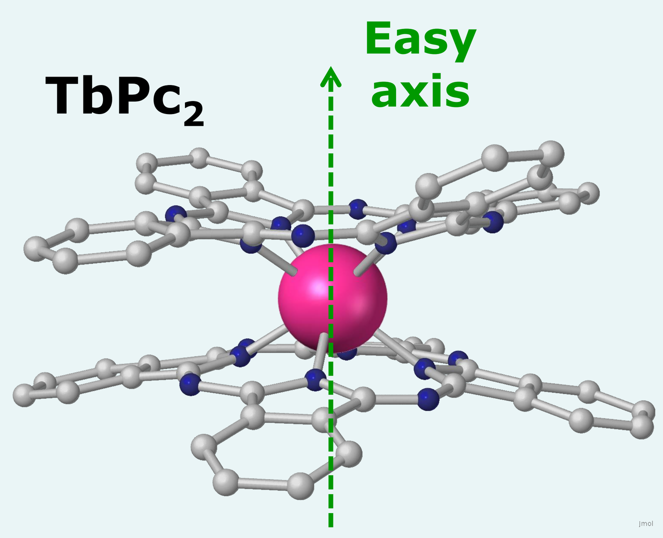
3a. $TbPc_2$ molecules between graphene electrodes: transport properties

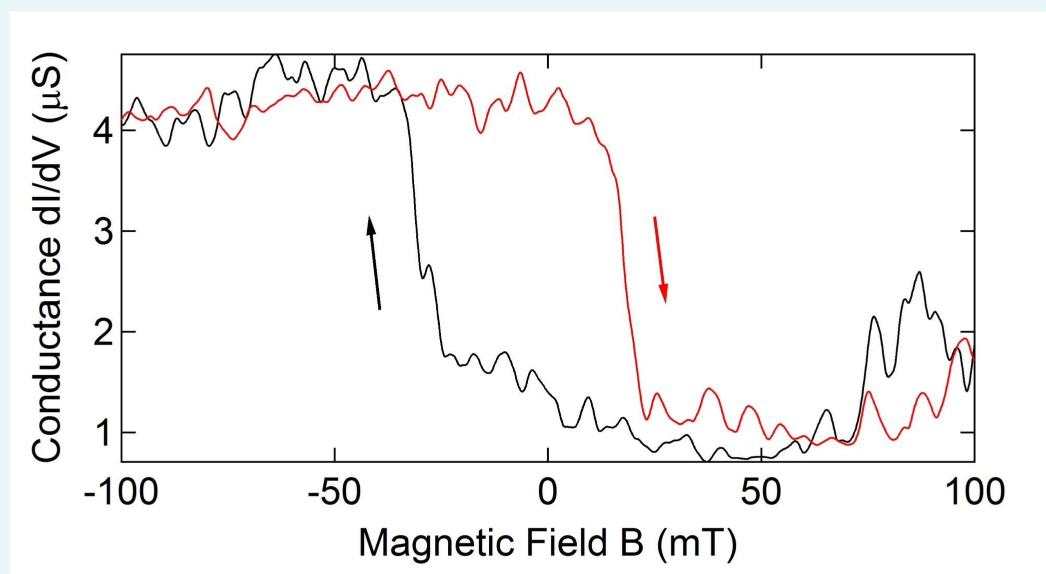
At low T (~100 mK) diamond-like features appear in the stability diagrams: charge transport is in the **Coulomb blockade regime**.



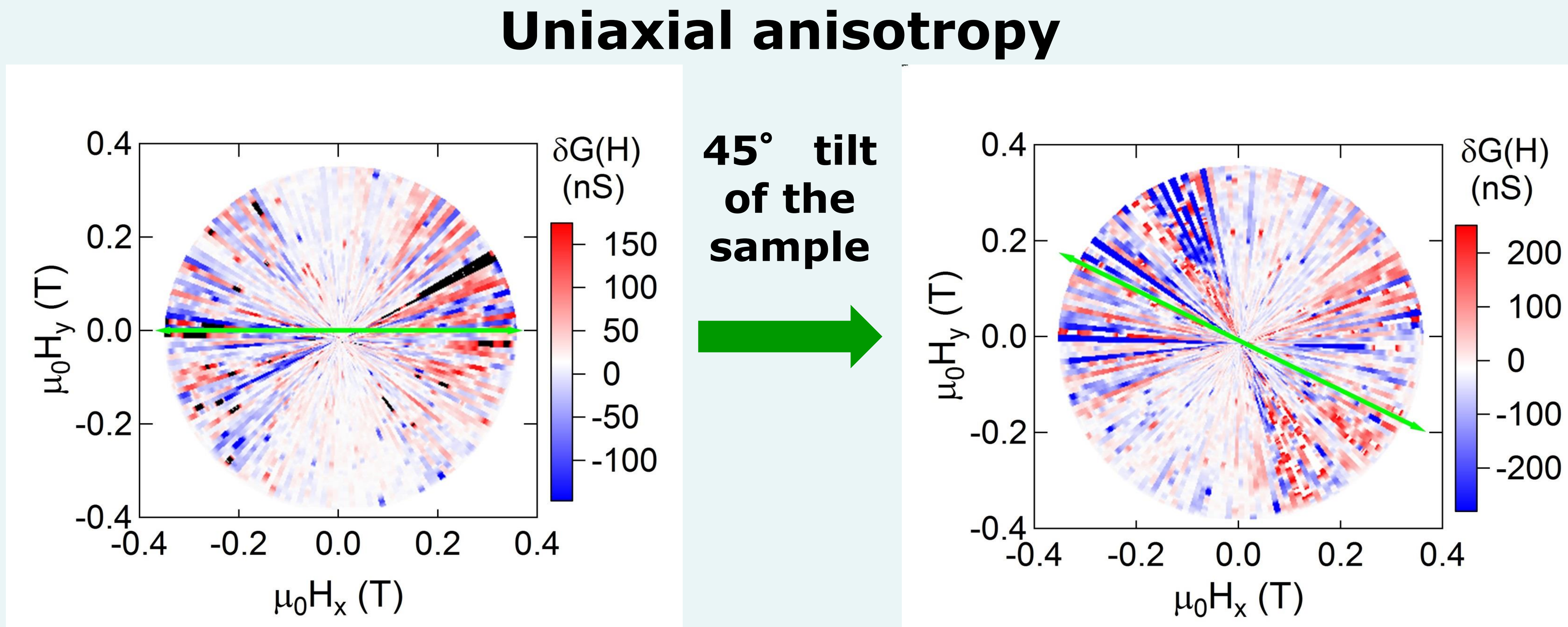
3b. $TbPc_2$ molecules between graphene electrodes: spin properties

Abrupt jumps in the magneto-conductance are likely due to the switching of the $TbPc_2$ electronic spin.

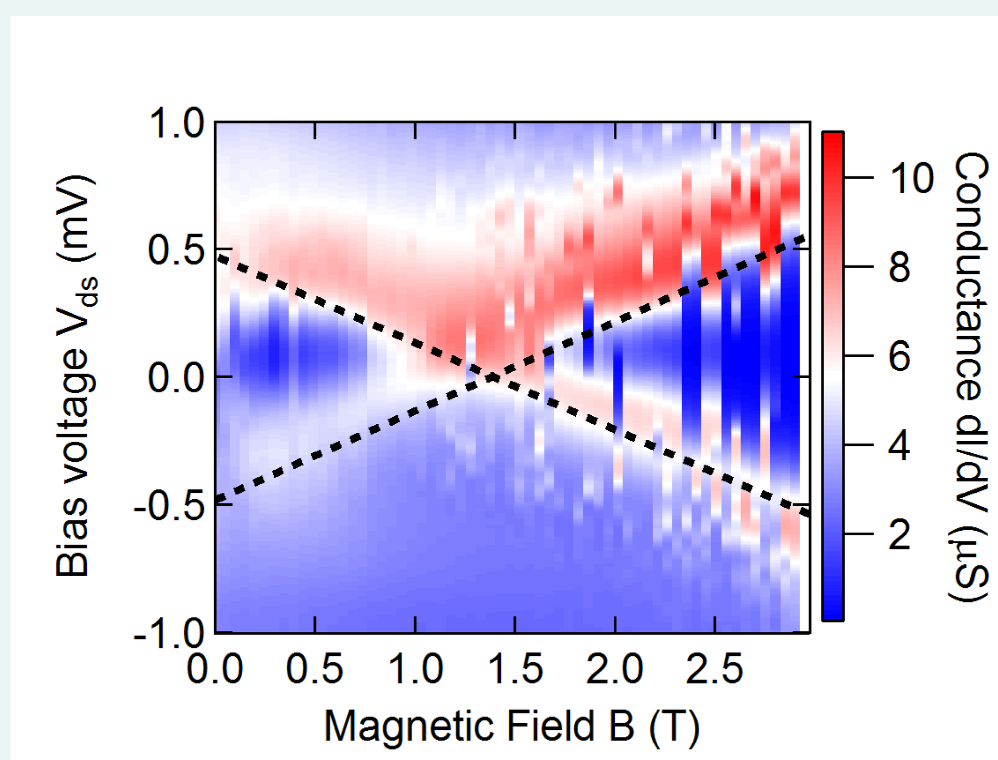




Uniaxial anisotropy



A strong **antiferromagnetic coupling** to the Tb^{3+} electronic spin could explain the splitting of the spin ½ Kondo peak at zero magnetic field.



References:

[1] A. Candini et al., Beilstein J. Nanotechnol. **6**, 711 (2015)

[2] F. Prins et al., Nano Lett. **11**, 4607 (2011)