Graphene nanostructures on Ni(111): structural, electronic and scattering properties.

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The electronic structure at the interface between graphene and metal contacts determines the charge and spin injection efficiency into graphene and is therefore a fundamental issue for the performance of nanodevices. Weakly interacting metal contacts simply dope the Dirac bands [1]. The interface with more reactive metals, however, is usually characterized by significant electronic reconstruction at both graphene and the metallic surface underneath, defining a complex scenario for scattering. The graphene-Ni interface represents an interesting case where the interaction with the ferromagnetic substrate opens hybridization gaps and induces magnetic moments [2,3]. Consequently, graphene is predicted to behave as a perfect spin filter in contact with a magnetic Ni electrode.

Previous studies focused on electron injection perpendicular to this interface. We investigate electron scattering in the most common current-in-plane geometry. For that purpose we grow graphene nanoislands on Ni(111) with varying geometry and atomically controlled edges. The shape can be selected by controlling the reaction temperature during the CVD growth [4], whereas the stacking with the substrate stabilizes different edge configurations depending on their relative orientation [5]. The electronic and scattering properties of the nanoislands are studied by combining local tunnelling spectroscopy and ab initio calculations [6]. We find that the hybridization between graphene and Ni states results in strongly reflecting graphene edges. Quantum interference patterns formed around the islands reveal a spin-dependent scattering of the Shockley bands of Ni, which we attribute to their distinct coupling to bulk states. Moreover, we find a strong dependence of the scattering amplitude on the atomic structure of the edges, depending on the orbital character and energy of the surface states.

References

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Figures

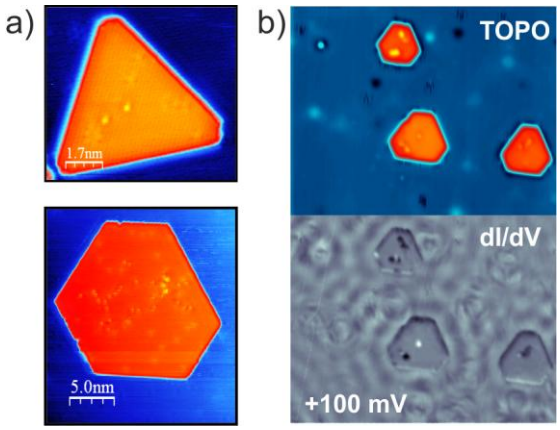

Figure 1: a) Triangular and hexagonal graphene nanoislands grown on Ni(111) by CVD. b) Simultaneously acquired topographic and constant current dI/dV maps showing the interference patterns of the a Ni surface state scattered from graphene islands.