The atomic and electronic structure of well-defined graphene nanoribbons studied by scanning probe microscopy

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Many applications have been envisioned for graphene, a monolayer of carbon atoms packed in a hexagonal lattice [1,2]. However, the fact that graphene remains metallic even at the neutrality point is a major problem for applications in (opto-)electronic devices. One possible way to introduce a bandgap in graphene is by fabricating narrow gaphene ribbons. The electronic and magnetic properties of such nanostructures sensitively depend on the atomic structure of the edges. Recent advances in the on-surface synthesis of graphene nanoribbons (GNRs) have made it possible to manufacture atomically well-defined, narrow, GNRs with arm-chair edges and a band-gap in excess of 2 eV [3-5].

By combining scanning tunneling microscopy (STM) and atomic force microscopy (AFM) with reactive and non-reactive tips, we can relate the electronic properties of the GNRs with their atomic structure. Furthermore, we can use the STM tip to (i) deliberately create well-defined atomic scale defects and (ii) control the interaction with the substrate. Hence, we are able to directly study the robustness of the properties of the graphene nanostructures.

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