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

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Despite the recent interest in graphene, there is still a lack of experimental studies on the electronic properties of atomically well defined graphene nanostructures. In order to have full control over the size, shape and edges of graphene nanostructures we use a chemical approach[1] to grow graphene nanoribbons (GNRs) on a gold (111) substrates. The GNRs have a fixed width and edge termination as determined by the choice of chemical precursor, resulting in armchair edges along the long axis of the ribbon and zigzag ends along the short axis.

We studied the GNRs using scanning tunneling microscopy and spectroscopy as well as atomic force microscopy. We measured the atomic structure of individual GNRs and spatially resolved the local density of states at different energy values. We find that the electronic states of the GNRs close to the Dirac point are located at the zigzag ends of the nanoribbons, whereas the states far away from the Dirac point are located mostly along the armchair edges (figure 1). Comparison of our experimental results with density functional theory indicates that the states at the zigzag ends are spin polarized whereas the states along the armchair edge are spin degenerate.

References

[1] J. Cai *et al.,* Nature, **446** (2010) 470-473.

Figures

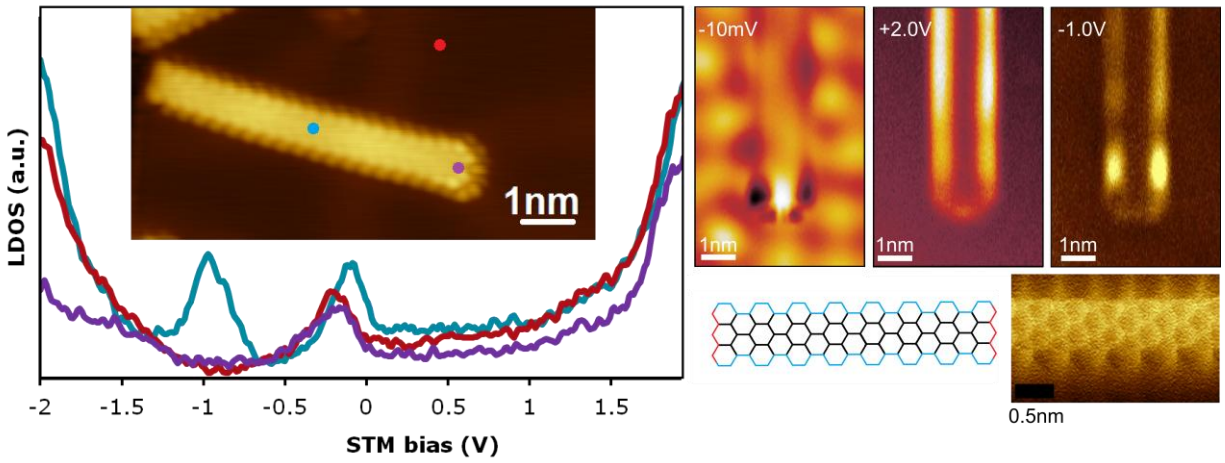

Figure 1. Energy spectroscopy on a GNR (left). Mapping the local density of states shows that states around the Dirac point are localized on the zigzag ends of the ribbon, while states far away from the Dirac point are more localized along the armchair edges (right top). The model for the GNR indicating the armchair edges in blue and the zigzag ends in red shown together with an AFM image of the atomic backbone of one of the GNRs (right bottom).