Confined states and edge state on graphene nanoislands probed by scanning tunneling spectroscopy

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Epitaxial graphene islands are prepared by ethylene deposition on Ir(111) at room temperature and subsequent annealing to 1050°C. The lateral dimension of the islands varies from 5 nm to 40 nm. Using scanning tunneling spectroscopy we were able to visualize confined states within the islands. The state energies and corresponding local density of states patterns are in good agreement with third nearest neighbor tight-binding calculations for graphene. However, we had to include the potential of the moiré structure as well as a strongly absorbing character of the edge states. The width of the confined state energy peaks has been used to determine the lifetime of the Dirac electrons, which is inversely proportional to energy. Atomic resolution STM images show singly saturated zigzag edges which are predicted to feature a spin-polarized state. STS measurements at the graphene edge partly show a pronounced peak at the Fermi level. A similar peak with lower intensity at the Fermi level is measured on the iridium, which could be identified as a surface state. This suggests that the increase in intensity at the edge of the graphene is due to a coupling of the edge state to the iridium surface state which enhanced strongly the intensity of the peak. Spin-polarized STS has been performed using an antiferromagnetic chrome tip in order to analyze the magnetic character of the edge state.

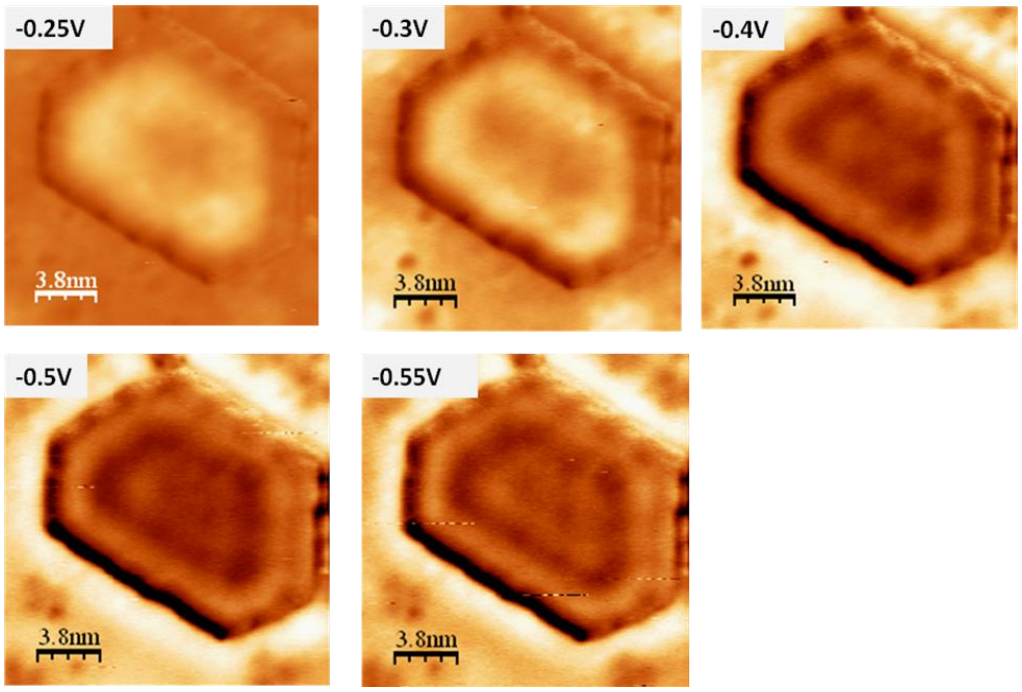

Fig. 1: dI/dV images at different sample voltage provide confined states on graphene island.