Scanning Probe Microscopy on Graphene Quantum Dots

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I will present data of wave function mapping in graphene quantum dots deposited on an Ir(111) surface [1]. These quantum dots are confined exclusively by zig-zag edges. However, edge states are absent due to an exchange interaction of the π-bands of graphene with the d_{z2} surface states of the Ir(111) as evidenced by a combination of density functional theory calculations and scanning tunneling spectroscopy data. The same exchange interaction, which gets continuously smaller away from the edges, leads to a weak confinement of the quantum dot states. It turns out that this weak confinement is decisive to achieve rather regular wave functions within the quantum dots as observed experimentally (Fig. 1). Good agreement for the wave function energies is achieved by a simple analytic model, but careful analysis of the probed wave function patterns reveals that their appearance is additionally influenced by the penetration of an sp-like surface state of Ir(111) into graphene.
In addition, I will show how graphene quantum dots can be produced on graphene flakes by local anodic oxidation using an atomic force microscope.

References

[1] D. Subramaniam et al., *Phys. Rev. Lett.* **108** (2012) 046801.

Figures

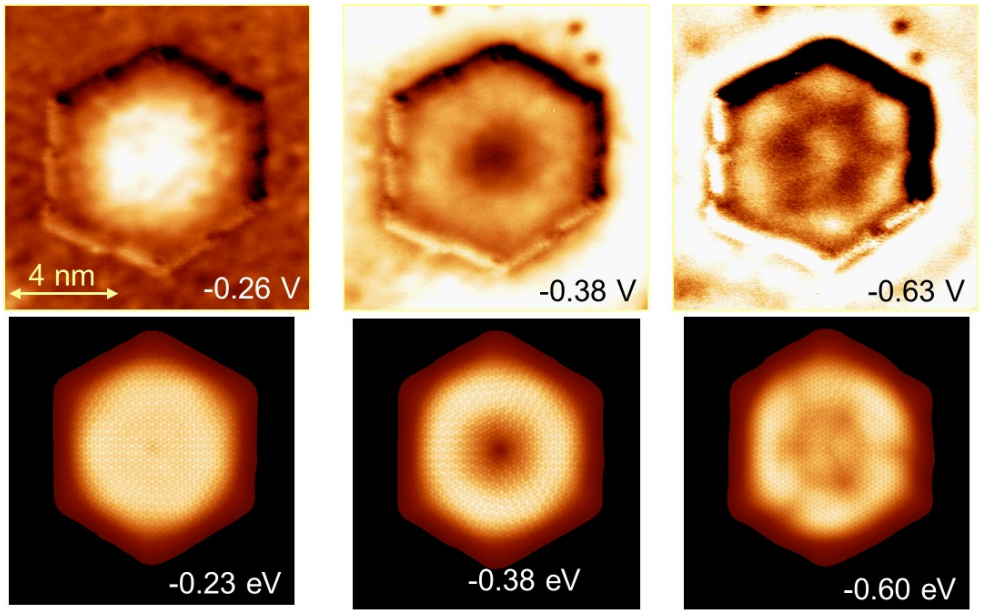

Figure caption. Scanning tunneling spectroscopy images (upper line) of a graphene quantum dot deposited on Ir(111) in comparison with the local density of states calculated by a tight binding model (lower line). Measurement voltages and energies are indicated [1].