Direct Observation of Electron Confinement in Epitaxial Graphene Nanoislands

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One leading question for the application of graphene in nanoelectronics is how electronic properties depend on the size at the nanoscale. Direct observation of the quantized electronic states is central to conveying the relationship between electronic structures and local geometry. Scanning tunneling spectroscopy was used to measure differential conductance dI/dV patterns of nanometer-size graphene islands on an Ir(111) surface. Energy resolved dI/dV maps clearly show a spatial modulation, indicating a modulated local density of states due to quantum confinement. We extract the electron dispersion relation from a quantitative energy dependent Fourier-analysis of the modulation pattern. We find a linear dispersion relation with $E = E_0 \pm \hbar v_F|k|$, with $E_0 = -0.09\pm0.02$ eV and Fermi velocity $v_F = (6.0\pm0.4) \times10^5$ m/s. This value is smaller as compared to previously published results on graphene/Ir(111),[1-3] $(9.0\pm1.2) \times10^5$ m/s. We discuss possible reasons for this difference.

References

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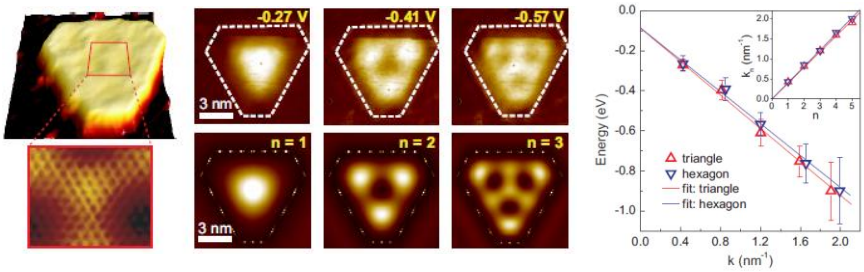
Figure



(left) Energy-dependent spatial modulations of dI/dV signals in a graphene nanoisland.
(right) Electron dispersion E(k) extracted from the wave vectors of the modulation patterns.