Size quantization effects in quasiparticle interference on epitaxial graphene nanoflakes

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Abstract
Graphene nanostructures represent an exciting topic for research, as a strong spatial confinement together with the edge structure impose new electronic properties, making them promising candidates for future nanoscale electronic units. By means of low-temperature scanning tunnelling microscopy and spectroscopy we investigate the electronic properties of elongated quasi-freestanding epitaxial graphene nanoflakes (GNFs) on Ag(111) and Au(111). Samples are prepared by temperature programmed growth of graphene flakes on Ir(111) and subsequent intercalation of noble metals. This procedure allows us to produce GNFs of different shapes and sizes exhibiting no substantial edge bonding towards the substrate [1]. The edges display an edge configuration with long-range zigzag or rougher zigzag sections with single hydrogen termination.

We implement local density of states (LDOS) mapping to analyze standing wave patterns arising from elastic scattering processes within single nanoflakes [2,3]. The Fourier analysis of the obtained LDOS maps shows that characteristic ringlike features due to the intervalley and intravalley scattering observed for large graphene sheets are also visible on the GNFs with lateral sizes down to 20nm. For GNFs, additional features appear inside the ringlike structures, which can be related to the transverse confinement in a nanoflake [4]. The scattering processes between the confinement-induced discrete bands in the nanoribbon electronic structure observed in flakes with a width of 100 nm indicate a large electron coherence length, though these features appeared less prominent within the Fourier transform for larger flakes. Our experimental results are supported by tight-binding calculations of realistic flakes, which very well reproduce the experimentally observed fingerprints of confinement in the Fourier transform of the standing wave patterns and confirm the strong influence of edge type as well as confinement direction and dimensions on the scattering in GNFs.

References
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Figures

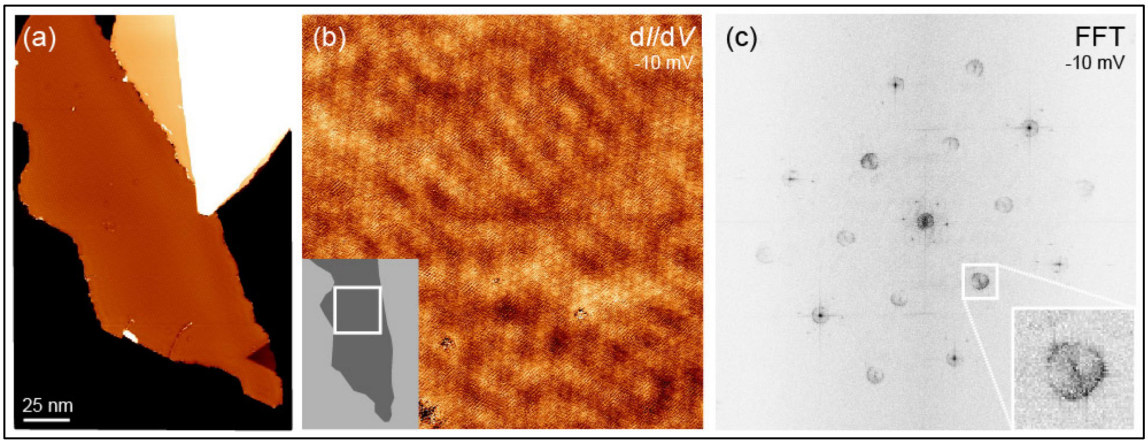

Figure 1 (a) Topography of an investigated graphene flake on Ag(111). (b) QPI mapping with atomic resolution (scanning parameters: 54x54 nm^2, V = -10mV, I = 0.8 nA, V_{mod} = 3 mV), the inset indicates the mapping position on the flake. (c) FFT of the obtained mapping. The inset shows a magnification of the intervalley scattering rings with clearly visible confinement features inside the characteristic trigonally warped circles. All measurements were carried out at 10 K.