Angle-dependent coupling of twisted graphene layers epitaxially grown on Ir(111)

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Epitaxial growth on metallic substrates is one of the most powerful approaches in producing large-scale, high-quality monolayer graphene [1]. However, it remains still a major challenge to achieve a controllable growth of multilayers.
This work is devoted to the investigation of multilayered graphene systems epitaxially grown on a transition metal, namely Ir(111). We address the growth and the electronic properties of twisted graphene layers (Figure 1) prepared by intercalation of atomic carbon under the epitaxially grown graphene monolayer on Ir(111). The electronic properties, studied by scanning tunneling spectroscopy (STS), reveal a strong dependence on the rotation angle between graphene layers, which can be estimated by the analysis of the moire structures (Figure 1). For the monolayer, as well as for bilayers with small-angle rotations, no Landau levels are observed in magnetic fields up to 6 Tesla (Figure 2). Whereas bilayers with a large twist angle show pronounced Landau levels characteristic of free standing graphene, suggesting a sufficient decoupling of the upper graphene layer (Figure 2). For twisted trilayers an even higher degree of decoupling is observed, showing a doping level and particle lifetimes values similar to previous results on other substrates [2,3]. Thus, twisted graphene layers on Ir(111) provide an ideal platform to study the electronic properties of epitaxially grown graphene and to analyse the influence of typical defects, as well as of the metal substrate, on the behaviour of charge carriers in high magnetic fields.

References

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Figures

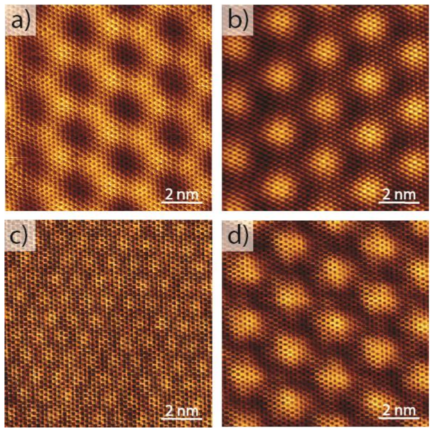

Figure 1: 10 x10 nm² topographs of: a) monolayer graphene on Ir(111); (b-c) graphene bilayers on Ir(111) with different rotation angles (0° and 13°, respectively); d) graphene trilayer on Ir(111).

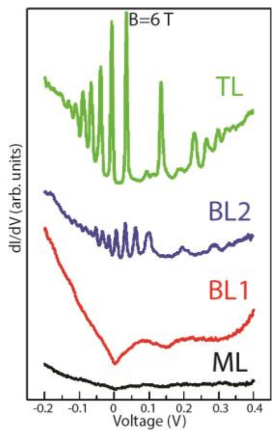

Figure 2: STS spectra acquired at a magnetic field of 6 T on the four different areas presented above (T=6.5 K).