

Atomic structure, electronic properties and manipulation of epitaxial graphene nanoflakes on Au(111)

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Graphene nanoribbons and graphene nanoflakes (GNFs) have been proposed to exhibit such peculiar phenomena like localized edge states [1] or edge magnetism [2]. Recent attempts of measuring the properties of GNFs on Ir(111) have revealed detrimental edge bonding of graphene to the employed Ir substrate [3,4]. The aim of the present scanning tunneling microscopy (STM) study is the investigation of structural and electronic properties of epitaxial GNFs on the Au(111) surface to further reduce the graphene edge - substrate interaction.

In the present work the preparation of GNFs was performed by a two step process. At the first step, well-shaped GNFs of different sizes down to several nanometers are prepared on the Ir(111) substrate by the temperature programmed growth. At the second step, a thick Au layer was deposited on top of the sample followed by a high temperature annealing, yielding GNFs on a high-quality Au(111) surface. After the preparation two types of GNFs are observed: Whereas embedded GNFs are incorporated in the gold surface, we also observe quasi-freestanding GNFs floating on top of the Au(111) surface.

The structure of both types of GNFs is investigated by STM and shows a moiré contrast depending on the rotation of the flake with respect to the Au lattice, which is additionally modulated by the Au(111) herringbone reconstruction. The hexagonal moiré structure undergoes a switch of the ring-fcc to ring-hcp positions when crossing a Herringbone reconstruction line as a result of the switching of Au positions from fcc to hcp.

We show that quasi-freestanding flakes can be easily manipulated across terraces by the STM tip regardless the size by scanning with appropriate tip parameters. Furthermore eminent quantum interference patterns at the flake edges are observed which propose very weak coupling of the graphene to the Au(111) surface not only in the bulk but also at edges.

References

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Figures

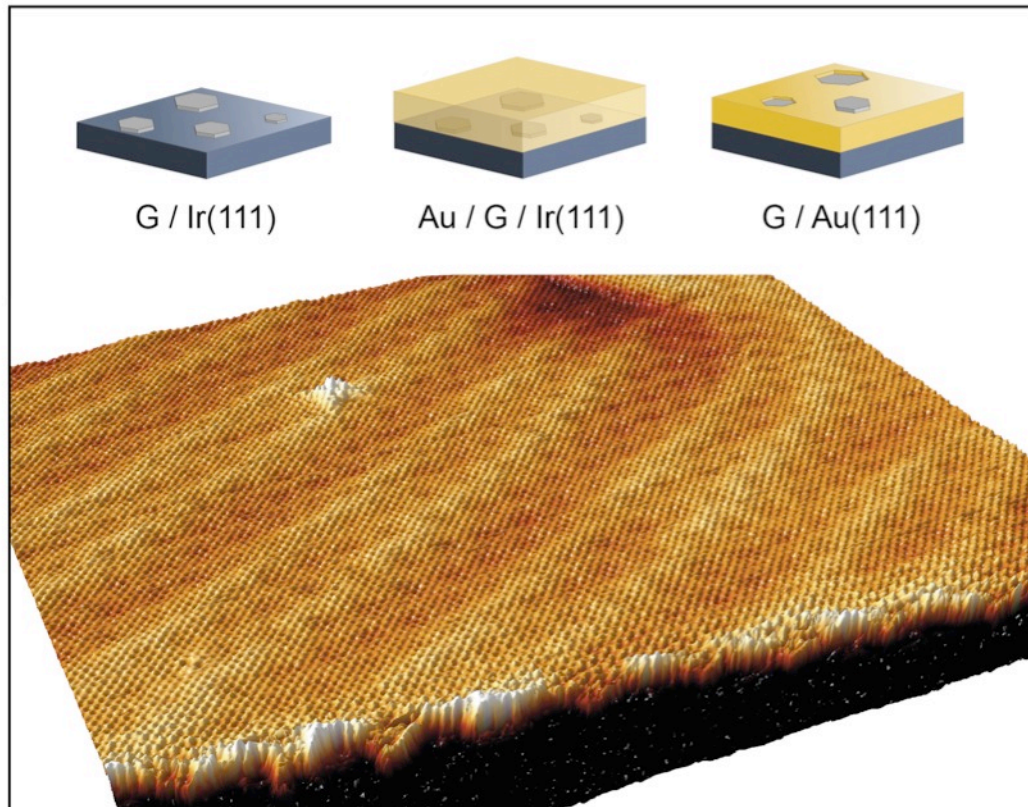


Fig. 1: Schematic of graphene nano flake formation on Au(111) (top) and 3D topographic image of quasi-freestanding graphene flake on Au(111). The image shows herringbone reconstruction, moiré and atomic resolution accompanied by the interference pattern at the edge (bottom).