Structure and dynamics of two-dimensional layers with low energy electron microscopy and nano-diffraction

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Low energy electron microscopy and nano-low energy electron diffraction offer unique and complementary capabilities for studying the structure and dynamics of inhomogeneous surfaces, thin films and two-dimensional layers with high spatial/temporal resolution. These diverse capabilities will be demonstrated by studies of the defect structure of graphene(g)/metals and anomalous diffusive dynamics of the Pb wetting layer on the Si(111) surface. The prevalence of defects in large-area graphene fabricated on metal substrates is of interest because it may undermine the unique physical and electronic properties that are vital to its use in technological applications. Our investigations reveal the proliferation of lattice orientational disorder and small angle grain boundaries in g/Ru(0001) [1]. On the contrary, incommensurability and polymorphism are observed in graphene that exhibits greater orientational uniformity (Fig. 1). Two-dimensional strain mapping in g/Ir(111) reveals inhomogeneous strain relaxation by wrinkles that form due to lattice mismatch with the substrate (Fig. 1). This suggests that it may be possible to strain engineer the properties of graphene if wrinkling can be controlled to form desirable wrinkle networks. Diffusion dynamics in Pb/Si(111) was investigated by monitoring the relaxation of non-uniform coverage profiles prepared by laser induced thermal desorption [2,3]. The sensitivity of diffraction satellite peaks produced by the wetting layer to its density is exploited to determine local Pb coverage with 0.001 monolayer precision using nano-LEED. Profile evolution observed in real-space and detailed coverage profiles extracted from reciprocal-space features contradict expectations of classical gradient-driven mass flow. Instead, they suggest an exceptional collective super-diffusive mechanism, whereby the Pb layer slides cohesively over the substrate surface.

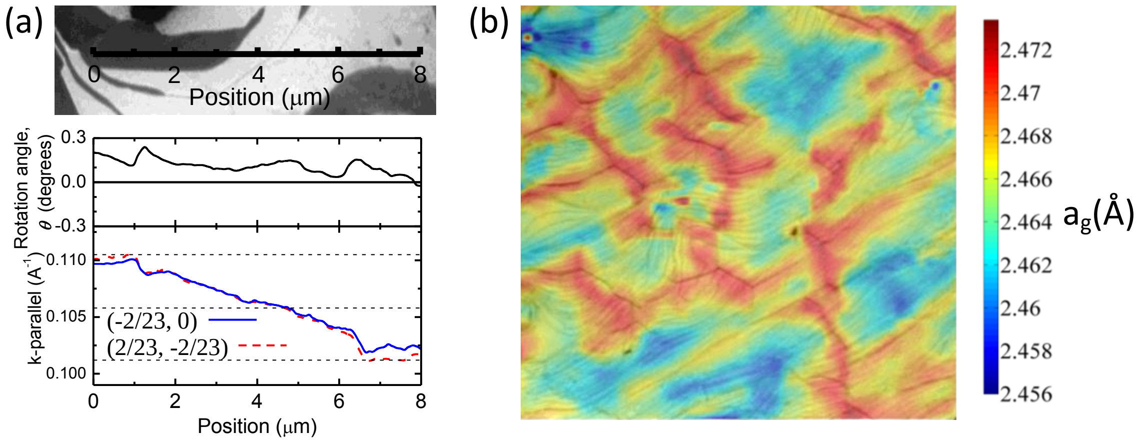

Figure caption: (a) Lattice rotations, incommensurability and polymorphism in g/Ru(0001) and (b) localized strain relaxation near wrinkles in g/Ir(111) are obtained from moiré diffraction peak positions using nano-LEED.

References:

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