From perfect graphene to intercalation compounds and cluster superlattices

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Carefully optimizing the growth of graphene on Ir(111) by scanning tunneling microscopy and low energy electron microscopy yields a virtually defect free epitaxial monolayer of macroscopic extension. With the help of the aforementioned microscopies, density functional theory (DFT), van der Waals – DFT, angle resolved photo emission, X-ray standing waves, high resolution X-ray core level spectroscopy and X-ray diffraction we develop a consistent picture of the electronic and geometric structure of graphene on Ir(111) and its bonding to the substrate.
Graphene on Ir(111) can be used as a laboratory to construct new types of graphene based compound materials. Specifically, patterned adsorption of atoms and molecules takes place resulting in cluster superlattices with exciting magnetic and catalytic properties. Intercalation underneath the graphene allows one to manipulate the properties of graphene itself, e.g. its ability to adsorb atoms and molecules as well as its magnetism.