Graphene on Ir(111): A weakly bonded system

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Epitaxial growth on metal surfaces is an established method to produce highly ordered, extended graphene sheets. Ir(111) stands out from other substrates as the graphene grown on it is of extraordinary structural quality [1], shows an electronic structure almost equivalent to the one of free graphene [2], and can serve as a template for the growth of ordered superlattices of metal clusters [3]. Here I report measurements of the structure of graphene / Ir(111) based on X-ray standing waves (XSW), density functional theory (DFT) and scanning tunneling microscopy (STM). XSW reveals a bonding distance of (3.42 ± 0.02) Å between graphene and the substrate. This height can be accurately confirmed in DFT if Van-der-Waals- interaction is taken into account. STM experiments show that due to the mismatch of graphene and Ir(111) an incommensurate moiré pattern is formed. The chemical interaction between C and Ir as determined by DFT is attractive only in some regions of the superstructure, whereas it is even repulsive for other parts. This is the reason for the significant corrugation of the graphene.Deposition of clusters broadens the height distribution in the underlying graphene, in agreement with the proposed rehybridisation model for cluster binding.

[1] J. Coraux, A. T. N'Diaye, C. Busse, and T. Michely, Nano Lett. **8**, 565 (2008).
[2] I. Pletikosić, M. Kralj, P. Pervan, R. Brako, J. Coraux, A. T. N'Diaye, C. Busse, and T. Michely, Phys. Rev. Lett. **102**, 056808 (2009).
[3] A. T. N'Diaye, T. Gerber, C. Busse, J. Mysliveček, J. Coraux, T. Michely, New. J. Phys. **11**, 103045 (2009)

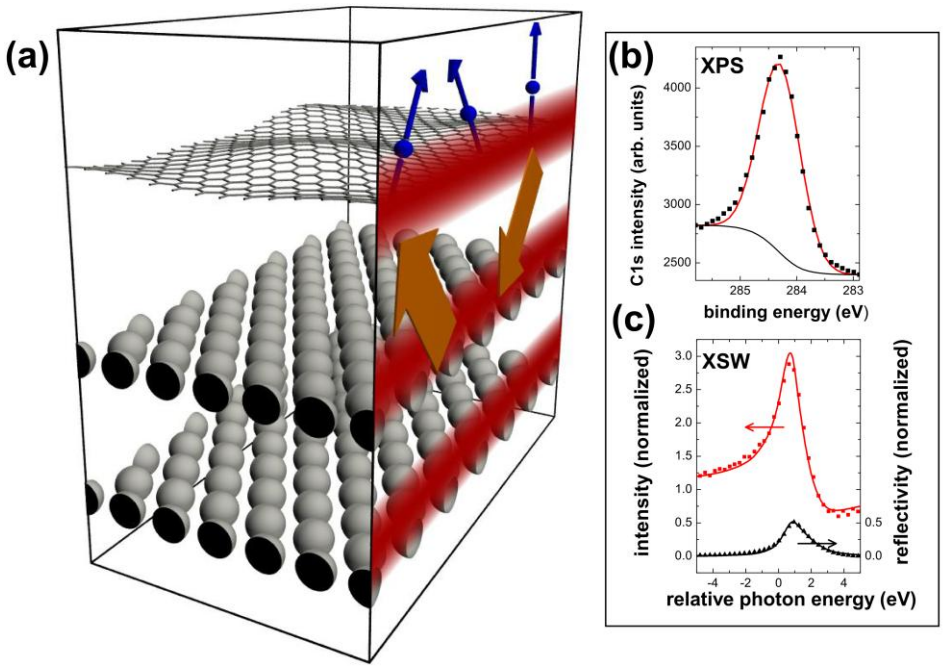

FIG. 1: (a) Schematic representation of the X-ray standing wave experiments. Depicted is a corrugated honeycomb mesh of graphene on top of two Ir(111) lattice planes. Orange arrows: Interfering incoming and outgoing X-ray beam. Red stripes: Standing wave pattern. Blue spheres and arrows: Emitted photoelectrons. (b) Squares: X-ray photoemission intensity of the C1s-peak. Thin line: Shirley-type background, Thick line: Gaussian fit. (c) X-ray reflectivity (triangles) and C1s photoemission yield during an XSW energy scan