Epitaxial graphene on metals and hybrid systems

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A number of transition metals may serve a supports and catalysts for the growth of epitaxial graphene. In the last few years synthesis routes which were historically parallel are converging: on one hand, preparation under ultra-clean conditions, namely under ultra-high vacuum and at the surface of single crystal metals; on the other hand, growth under pressures approaching atmospheric conditions, at the surface of metallic thin films. In both cases graphene layers having high quality can be obtained. The first approach delivers model systems especially suited to fine surface science studies. The second approach is motivated by the prospect for mass production of graphene.

I will present our recent studies on a particular graphene/metal system which is a case study for graphene weakly interacting on its substrate, graphene/Ir(111), which we have been revisiting since 2007 and allows for the preparation of ultra-high quality graphene [1-5]. I will show that van der Waals bonding, modulated by a slight tendency to covalent bonding, ensures cohesion in this system [6]. I will then present our recent studies devoted to the deposit of metals on graphene/Ir(111), which leads to ordered two-dimensional arrays of magnetic nanoclusters [7] or ultra-thin magnetic films intercalated between graphene and its metallic substrate [8].

References
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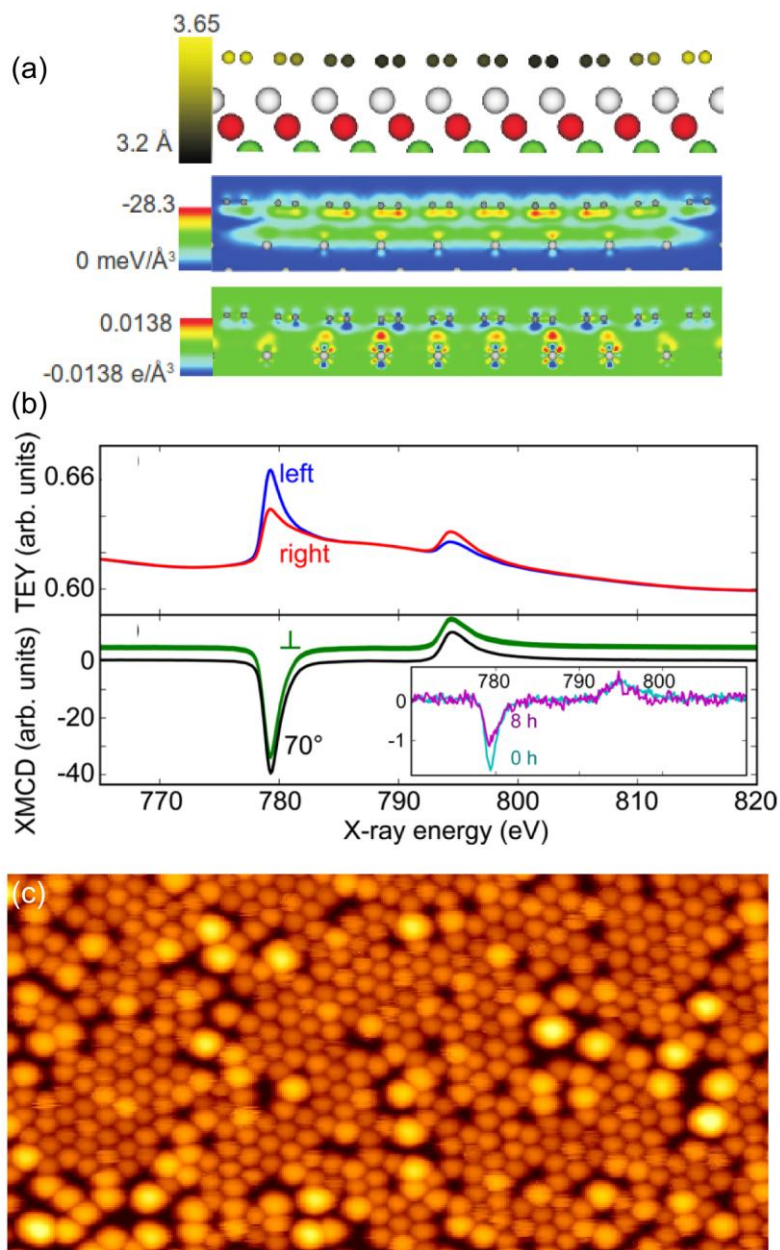[8] J. Coraux, A. T. N'Diaye, N. Rougemaille, unpublished.

Figure: (a) Side views of the structure (top), non local correlation binding energy density (middle), and charge transfer (bottom) for graphene/Ir(111), as derived from density functional theory calculations including van der Waals interactions. (b) Total electron yield from Co rich nanoclusters on graphene/Ir(111), across the $L_{2,3}$ Co absorption edges for left and right circularly polarized X-rays at 5 T and 10 K (top), dichroic signal for X-rays impinging the sample perpendicular and inclined (bottom). (c) Scanning tunnelling microscopy topograph ($90{\times}50$ nm^2) of the Co rich clusters on graphene/Ir(111).