Graphene on Ru(0001): a combined STM, NC-AFM and FM-KPFM study

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The possibility of producing single layers of graphene has opened a fascinating new world of physical phenomena in two dimensions and a new route towards all-carbon electronics. Graphene grown on metallic substrates could be important as a source for free-standing graphene samples after dissolving the metallic substrate but it is also of utmost importance from a fundamental point of view. The bonding interaction of the graphene monolayer and the modification of its electronic structure strongly depend on the metallic substrate [1].

In our study graphene was grown by chemical vapor deposition of ethylene on Ru(0001) at elevated temperatures. Recently, we succeeded in monitoring different growth mechanisms of graphene on Ru(0001) by high temperature scanning tunneling microscopy (STM) [2].
To further elucidate the properties of this fascinating material, complementary studies of the electronic and geometrical structure of graphene using STM, noncontact atomic force microscopy (NC-AFM) (see Fig. 1), and frequency-modulation Kelvin probe force microscopy (FM-KPFM) (see Fig. 2) were applied. Combined experiments were carried out with a commercial SPM 150 Aarhus equipped with the piezoelectric KolibriSensor® [3] in ultra-high vacuum. The sensor enables simultaneous STM and NC-AFM experiments [3] beneficial for the study of graphene on Ru(0001).

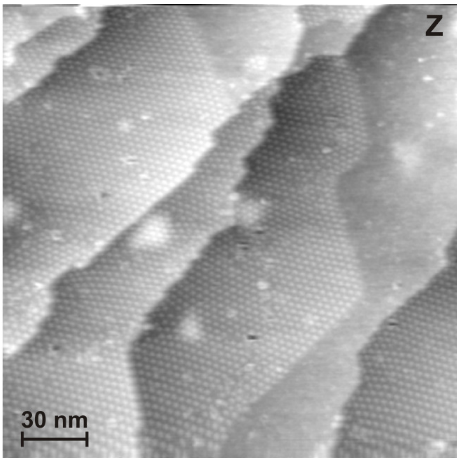

Figure 1: Large scale topographic NC-AFM image of graphene on Ru(0001) at room temperature. The graphene monolayer shows the characteristic buckling resulting in a hexagonal reconstruction.

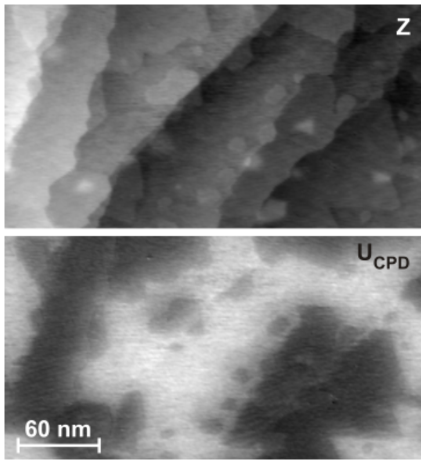

Figure 2: FM-KPFM image of graphene on Ru(0001). Bright areas in the contact potential map U_{CPD} correspond to the metal substrate.

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[2] S. Dänhardt, S. Günther, J. Wintterlin, S. Schmitt, submitted
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