Workfunction differences of C_{60} on oriented metal substrates

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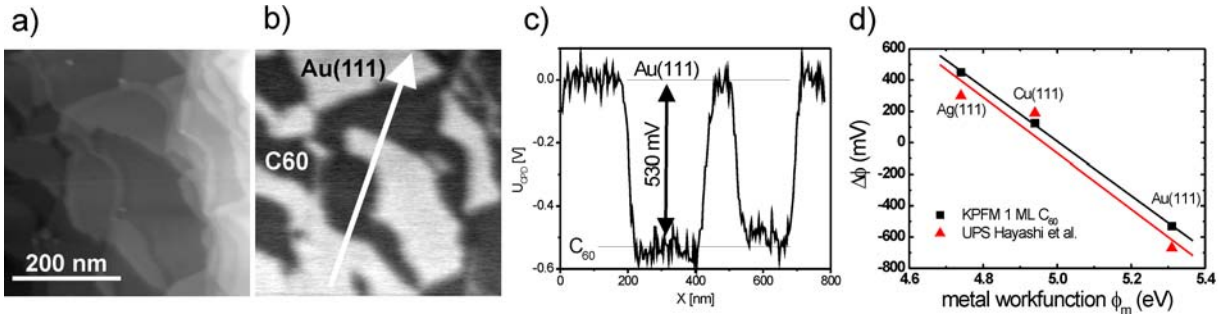
The interest in organic semiconductors considerably increased within the last years especially with respect to the production of organic light emitting diodes. In order to improve such devices, a low dipole barrier height for the injection of charge carriers from the metal electrode into the organic semiconductor is desirable. Most organic molecules show a linear dependence between the workfunction $\Delta\phi$ of the metal substrate and the dipole barrier built between the molecule and the surface as observed by UPS [1]. For C_{60}, this linear dependence was also proven by means of macroscopic Kelvin probe [2].
In a recent work, we demonstrated that Kelvin probe force microscopy (KPFM) [3] can be applied to deduce quantitative values for the dipole barrier on the nanometer scale in complete agreement with macroscopic UPS data. We apply this technique here in order to deduce the workfunction of different metal substrates at submonolayer C_{60} coverage. Figure a) and b) display the topography and KPFM signal of a Au(111) substrate covered with half a monolayer of C_{60}. The KPFM image clearly indicates a reduced workfunction $\Delta\phi$ between C_{60} covered and pure Au(111) surface areas. A cross section taken along the arrow in fig. b) is depicted in fig. c) and yields a value of $\Delta\phi$ = +530 mV, with ~ 25 nm lateral resolution. This value is in good agreement with the results by Hayashi et al. [2] as displayed in fig. d). In the same figure, also the results for Ag(111) and Cu(111) are shown, again with excellent agreement. It should be noted though, that our results reveal the locally measured $\Delta\phi$ for a single monolayer, in contrast to [2] and other work. Hence we do not suffer from averaging over covered / uncovered areas which affects $\Delta\phi$ considerably. Also, we discuss concepts how to enhance the lateral resolution in order to measure $\Delta\phi$ quantitatively of individual C_{60} molecules.



[1] I. G. Hill et al., *Appl. Phys. Lett.* ***73:*** *662 (1998)*
[2] N. Hayashi et al., *J. Appl. Phys.* ***92****: 3784 (2002)*
[3] U. Zerweck et al., *Phys. Rev. B* ***71****: 125424 (2005)*