

Adsorption of PTCDA on KBr covered Metal Substrates

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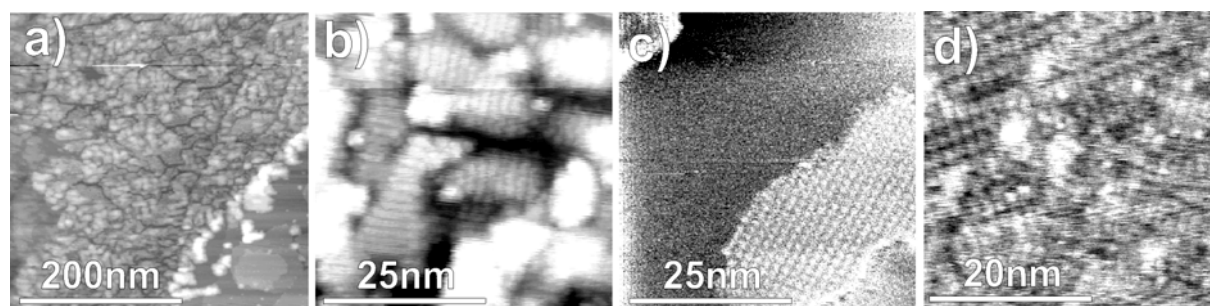
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The ordered growth of organic molecules on insulating surfaces represents a major problem mostly due to the weak interaction between molecules and substrate. Our study proposes a concept to control this interaction by using ultrathin alkali halide films on metals.

We investigated the adsorption mechanisms of PTCDA on various single crystal metal substrates covered with an ultrathin KBr film. On KBr covered Au(111), PTCDA formed large crystals similar to Kunstmann et al. [1]. However, on a KBr covered Ag(111) substrate, the molecular growth is completely different. Fig. (a) depicts the topography of an area where the Ag(111) was covered by a first monolayer (ML) KBr, and in the lower right corner by a second ML. On the first ML KBr, PTCDA forms small non-ordered aggregates and linear molecular arrangements growing in rows as displayed in fig. (b). On the two KBr layer covered Ag(111), larger PTCDA aggregates form near the upper step edge [fig. (a)] and an ordered layer-growth is observed far from the steps [fig. (c)]. For comparison, the growth on the pure Ag(111) substrate on a different area of the same sample is shown in fig. (d).

In order to understand the coverage and pattern formation of PTCDA clusters on these surfaces, we used a refined Ising-type model [2]. The simulations for different strengths of the adsorbate-adsorbate (J), the adsorbate-substrate (H), and the adsorbate-step interaction (Δ) reveal a cluster size distribution in good agreement with the experiment. Furthermore, the following conclusions can be drawn: H dominates on the pure Ag(111), J dominates on the second ML KBr, while H and J are competing on the first ML KBr.

Obviously, the adsorbate-substrate interaction H strongly depends on the metal substrate underneath the KBr film. Besides a different binding strength, the interface dipole between KBr and the metal might strongly influence H . The interface dipole can be designed in a wide range as previously shown for different alkali chlorides on Au(111) [3] and might be used to improve the bottom-up assembly in molecular electronics on insulating surfaces.



[1] T. Kunstmann et al., Phys. Rev. B **71**, 121403R (2005)

[2] K. Morawetz et al., submitted; C. Olbrich, bachelor thesis, TU Chemnitz (2004)

[3] Ch. Loppacher et al., Nanotechnology **15**, S9 (2004)