Influence of substrate morphology on organic layer growth: PTCDA on Ag(111) and Au(111)

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By Hg-excited photo-emission electron microscopy (PEEM) and low energy electron microscopy (LEEM) we investigated the microscopic growth behavior of organic thin films using 3,4,9,10-perylene-tetracarboxylic-acid dianhydride (PTCDA) on Ag(111) and Au(111) single crystal substrates, as example. Direct real-time observation allows to correlate the initial growth modes and the related kinetic parameters with substrate properties like terrace width, step density, and step bunches from the submonolayer range up to multilayers [1]. Above room temperature PTCDA grows in a Stranski–Krastanov fashion: after completion of the first two stable layers three-dimensional islands are formed. The nucleation density strongly depends on temperature and substrate morphology thus affecting the properties of the organic film. Even the growth mode itself is drastically influenced by the substrate morphology: on the Au(111) surface we observe simultaneously Stranski-Krastanov and layer-by-layer growth, depending on the local step density of the substrate. We furthermore report on the influence of the step bunches on the growth direction of the first and second layer. We also investigated the role of step bunches on the rotational domain boundaries. Dark field LEEM from the first layer of PTCDA on Ag(111) indicates that single domains even extend across several steps. The investigations lead to the conclusion that the organic films grow in a complex manner with manifold parameters.

[1] Marchetto et al., Chem. Phys. 325 (2006) 178-184