

Towards an Understanding of Self Assembling and Growth Mechanisms in Highly Ordered Organic Films

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In the last years substantial effort has been invested in investigating organic films and enormous progress has been made in growing thin films with a wide range of exciting and different properties. Thus, the investigation of growth, assembling and ordering mechanisms has become a topic of high academic interest as well as practical interest. Our work addresses the understanding of the role that different interactions play in the growth and ordering processes of organic films. We have performed a combined structural study by Atomic Force Microscopy and X-ray Diffraction.

First we present a study of the role of the molecule-substrate and intermolecular interactions on the structure of Self-Assembled Monolayers (SAMs) of alkanethiols on Au(111). Alkanethiols self-organize spontaneously forming a well ordered monolayer chemically bonded to the surface. We show that several structures consisting of molecules with different tilt angles and periodicities are formed before the completion of the monolayer. The stability and structure of the tilted phases vary with the chain-length. This is explained in terms of changes in the energetic balance between the molecule-substrate and intermolecular interactions.

Then we discuss the growth and structure of planar aromatic molecules by Organic Molecular beam epitaxy (OMBE). Contrary to SAMs, the molecules interact weakly with the substrate (van der Waals). Specifically we focus on the growth of copper-hexadecafluoro-phthalocyanine ($F_{16}PcCu$) on Al_2O_3 single crystals and SiO_2 . $F_{16}PcCu$ is interesting for applications in electronic and optoelectronic devices. The films present a similar layered structure perpendicular to the surface on both substrates. Interestingly, the Al_2O_3 surface induces the molecular assembling in unidirectionally oriented needle-like structures. We discuss different mechanisms leading to this anisotropic structure and different aspects of the growth for different thicknesses. As a strategy to tune the interaction between surface and molecules, the study has been extended to the growth onto surfaces functionalized by SAMs.