Initial Stage of para-Hexaphenyl Thin-Film Growth Controlled by the Step Structure of the Ion-Beam-Modified TiO2(110) Surface

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Organic electronics require a precise control over properties of a moleculeâEuro”substrate interface as well as film growth morphology, from both fundamental points of view, when a clean vacuum environment is needed and also under ambient air conditions. In this paper, we present submonolayer molecular films of para-hexaphenyl (6P) formation on the rutile TiO2(110) substrates and ways of affecting the growth and morphology via ion-beam nanopatterning. Ultrahigh vacuum deposition and measurements are followed by the film evolution study upon air exposure. Strongly anisotropic TiO2(110) surfaces, in the form of terraced ripples with a preserved (1 Ã- 1) structure, were controllably fabricated utilizing ion-beam bombardment and characterized by means of high-resolution scanning tunneling microscopy and low-energy electron diffraction. 6P thin films were prepared using organic molecular beam epitaxy and characterized in situ by noncontact atomic force microscopy. Ex situ characterization was performed by tapping-mode atomic force microscopy, scanning electron microscopy, and noncontact atomic force microscopy with molecular resolution. We have demonstrated that by changing the size of locally preserved (1 Ã- 1) surface areas, determined by the ripple parameters, different 6P assemblies can be promoted. With theStage of para-Hexaphenyl Thin-Film Growth Controlled by the Step Structure of the Ion-Beam-Modified TiO2(110) Surfaceaccompanied by a reorientation of the molecules from flat-lying to upright-standing. The resulting morphology depends on the structure of a two-dimensional phase of lying molecules formed at the initial stage of deposition, which can be either a well-ordered wetting layer or a two-dimensional mobile lattice gas. The postgrowth remainders of these two-dimensional phases participate in additional nucleation processes forming small islands or clusters.

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