Tip Induced Crystallization Lithography

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Abstract

The preparation of uniform large-area organic crystal arrays on substrates and controlling their shapes, morphologies, sizes, and densities plays an important role in material sciences and physics chemistry, such as producing high-quality organic thin film based semiconductors, solar cells, field-effect transistors, light-emitting diodes and promoting the sensitivity of chemical and biological sensors. It also aids in providing an environment to understand the thermodynamics, kinetics, sensitivity, and detonics of energetic materials in micro- or nano-scale. We developed a new atomic force microscopy (AFM) based technique, tip induced crystallization lithography (TICL), for efficiently fabricating large-area organic crystal arrays on various substrates. This technique depends on coating an amorphous organic thin film on a substrate and then inducing crystallization of the thin film using AFM tips. After removing the noncrystalline materials from the substrate by heating or solvent washing, the organic crystal arrays are obtained on the substrate. By adjusting the scanning features, crystal growth time, thin film thickness, size and density of noncrystalline particles in the original amorphous thin film, and substrate surface energy, the shape, morphology, size, and density of the patterned organic crystal arrays can be controlled. The size of the smallest feature made using TICL technique is less than 1 μm.