X-Ray Spectromicroscopy Studies of the Effect of Chain Length and Substrate Temperature on the Growth and Morphology of n-Alkane Thin Films

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X-ray microscopy has been used to study the morphology and growth of thin films of linear n-alkanes prepared by vacuum evaporation onto freshly cleaved NaCl(001) surfaces, where molecules can align along the [110] and [-110] directions on the NaCl(001) surface.

X-ray microscopy experiments were performed using the Scanning Transmission X-ray Microscopes (STXM) on beamlines 5.3.2 and 11.0.2. at the Advanced Light Source (ALS). NEXAFS microscopy at the Carbon K-edge reveals that the morphology and orientation of these vapor deposited n-alkane thin films changes systematically with the chain length and the substrate temperature during deposition. Figure 1 presents STXM images for hexacontane (HC, C_{60}H_{122}) deposited onto the NaCl(001) surface at different substrate temperatures recorded at 287.6 eV (e.g. C1s → σ*_{C-H} transition). These images show strong contrast, attributed to different molecular orientations of the different domains. The size of the domains depends on the deposition substrate temperature, an effect that can be attributed to the increased molecular mobility and a decreased crystal nucleation density during growth at elevated substrate temperatures. Complementary phenomena are observed when the chain length of the n-alkane molecules is varied.

(a) Room temp (b) 36°C (c) 40°C (d) 45°C

Figure 1. X-ray microscope images of hexacontane (C_{60}H_{122}) deposited onto NaCl(001) surfaces at different substrate temperatures. These images were recorded with a x-ray energy of 287.6 eV corresponding to the C 1s → C-H transition.

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