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Molecular orientation of α-sexithienyl on KBr substrate

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Introduction

Molecular orientation of organic semiconductor thin films on insulator substrates is important from a viewpoint of carrier mobility in organic transistors. α-sexithienyl (6T) is one of the candidates for organic semiconductor materials in the devices because of the high carrier mobility of its single crystal. Thus, control of molecular orientation of 6T thin film on insulator substrates is important for the development of high performance organic thin film transistors. In the present work, we studied the molecular orientation of 6T thin films grown on KBr, an ionic insulator material, in detail by near edge X-ray absorption fine structure (NEXAFS).

Experiment

Cleaved KBr(001) substrate was cleaned by annealing. 6T was evaporated from a Knudsen cell under the two conditions of substrate temperature (300 K and 380 K). S K-edge NEXAFS measurements were carried out at the soft x-ray double-crystal monochromator station BL-11B of the Photon Factory in the Institute of Materials Structure Science.

Results and Discussion

Figure 1 shows the polarization dependence of S K-edge NEXAFS. The both groups of spectra of different substrate temperatures show similar polarization dependence. The large intensity of π* (assigned to the S1s-to-π* transition) at normal incidence and large σ* (assigned to the S1s-to-σ* transition) at grazing incidence mean that the π* orbitals were parallel with the substrate surface and σ* orbitals were standing on the substrate. These features of the orbitals suggest that the rod-like 6T molecules had standing orientations on the KBr substrate at both substrate temperatures.

Rod-like (long-chain) organic molecules have general tendency to show lateral orientations at low temperatures (owing to the interaction between organic molecules and substrates) and normal orientations at high temperatures with respect to the substrate surfaces. In our case of 6T/KBr, the molecules showed normal orientation even at a low temperature (room temperature). This suggests that the interaction between 6T and KBr is very weak.

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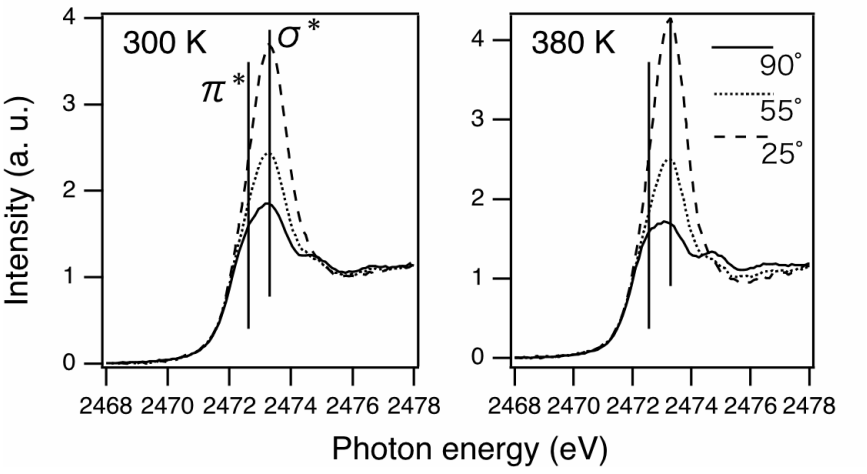

Figure 1
Polarization dependence of S K-edge NEXAFS for two 6T(10nm)/KBr samples deposited at two substrate temperatures. Measurements were performed at 300 K for both samples.