Investigation of Organic/Metal Interface by X-ray Photoelectron Spectroscopy and Scanning Tunneling Microscopy

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ABSTRACT

Molecules architecture on metal surfaces has been an important issue in exploration of nanodevices. Thereby, organic molecular films with large highly ordered configuration have attracted considerable interest as it provides a better insight into the intrinsic properties of the films themselves. In particular, the organic/metal interface properties have proven to be of vital importance in determining the chemical and physical properties of the up-growing films, and in defining the performance of the thin film device. Here, we discuss electronic and structural properties of NTCDA (1,4,5,8-naphthalence-tetracarboxylic dianhydrid) molecular films grown on metal single crystal surfaces. Using various techniques, we aimed to analyze the characteristics of the organic/metal interface. High-resolution and low temperature scanning tunneling microscopy (LT-STM) was utilized to obtain the detail of the two molecular domains predicted by low energy electron diffraction (LEED) experiment. In addition, we were able to visualize with high precision the molecular orbitals within the single molecule at the level of the naphthalene core. Photoemission including core level, valence band spectra was used to understand the chemical properties at the interface. By combining PES spectra and scanning tunneling spectroscopy (STS) data, we could determine the binding energies of both the HOMO feature and the LUMO partially-filled through a charge transfer process at the interface. On the other hand, the C K-edge near edge X-ray fine structure (NEXAFS) spectra confirm the strong interaction at the interface and by using angular dependence approach of the NEXAFS intensity we determined the exact orientation of the NTCDA molecules over the surface.

REFERENCE

1. Y. Tong, F. Nicolas, S. Kubsky, H. Oughaddou, F. Sirotti, V. Esaulov, and A. Bendounan, "Interplay between Structural and Electronic Properties in NTCDA Films on Cu(100)". J. Phys. Chem. C, 2017, 121 (9), pp 5050–5057.