Interface Studies of Molubdenum Disulfide (MoS_2) and Strong Electron Acceptor Organic Semiconductor (F4-TCNQ)

Yu-Ling Lai[1], Li-Chung Yu[1], Hung-Wei Shiu[1] and Yao-Jane Hsu[1, 2*]

[1]National Synchrotron Radiation Research Center, 101 Hsin-Ann Road, Hsinchu Science Park, Hsinchu, Taiwan
[2]Department of Photonics, National Cheng Kung University, Tainan, Taiwan
yjhsu@nsrrc.org.tw

Abstract

Organic semiconductors (OSCs) with low spin-orbital coupling and versatile functionality by tailoring the electronic structures, are used as a buffer layer in organic spintronic devices. Tetrafluoro-tetracyanoquinodimethane (F4-TCNQ) with strong electron acceptor is one of the OSCs which can be used to reduce the injection barrier for holes transport by forming an interfacial dipole at interface. Recently, MoS_2 have attracted much attention due to the superior electronic and optical properties for developing novel electronic devices. The interplay between these two heteromaterials, MoS_2 and organic semiconductor, might generate novel properties for potential electronic devices. In this work, we deposited F4-TCNQ on MoS_2 surface and characterized by X-ray photoelectron spectroscopy (XPS). At the contact of bulk MoS_2/F4-TCNQ interface, a small shift 0.05 eV towards higher BE was found for both Mo 3d and S 2p. The shifting peaks of Mo 3d and S 2p implied the surface dipole at the interface of MoS_2/OSCs. The Raman spectra of bulk MoS_2 and atop with F4TCNQ, two sharp Raman modes, E^1_{2g} (~383 cm^{-1}) and A_{1g} (~408 cm^{-1}), are observed. The difference of the Raman modes of E^1_{2g} and A_{1g} represents the number of layers of MoS_2. Our results display the difference between E^1_{2g} and A_{1g} are about 25 cm^{-1} which corresponding to bulk MoS_2 for all samples. Noticeably, a red shift of Raman modes was found for MoS_2 atop with F4-TCNQ. This red shift of Raman modes indicates that there might be a charge transfer occurs at the interface of MoS_2 and OSCs.

Keywords – OSCs, F4-TCNQ, MoS_2, XPS