Interface Studies of single layer Molubdenum Disulfide (MoS_2) and Organic Semiconductor (Feq_3 and F4-TCNQ)

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Abstract

MoS_2 with superior electronic and optical properties, such as high charge-carrier mobility, tunable charge-carrier types, and high on/off ratio, have attracted a lot of attention for developing novel electronic devices and were successfully fabricated to MoS_2-based semiconductor devices. In addition, organic semiconductors (OSCs) possess low spin-orbital coupling and hyperfine interaction to be used as a buffer layer in organic spintronic devices. To combine these two heteromaterials, MoS_2 and OSCs, might generate novel properties for potential electronic devices. Here, we use two kinds of OSCs, tris(8-hydroxyquinoline)iron(III) (Feq_3) and Tetrafluoro-tetracyanoquinodimethane (F4-TCNQ). The structure of Feq_3 with paramagnetic metal center is similar Alq_3 witch can tune electronic to change of the extion/trion ratio at Alq_3-MoS_2 interface. F4-TCNQ is a strong electron acceptor and can be used to reduce the injection barrier for holes transport by forming an interfacial dipole at interface. We deposited OSCs on single layer MoS_2(1L-MoS_2) and characterized by Raman, Photoluminescence(PL), Scanning Photoemission Microscopy (SPEM) and X-ray photoelectron spectroscopy (XPS). The Raman shows the difference between E^1_{2g} and A_{1g} which corresponding to 1L-MoS_2, and no change after depositing OSCs. The PL shows the trion increase after depositing Feq_3, but unobvious change after depositing F4-TCNQ. For the XPS, we observed the Mo 3d, S 2p and N 1s were all no variety after cover OSCs on 1L-MoS_2. Our results display that MoS_2 was so inner to have no reaction with OSCs (Feq_3 and F4-TCNQ) on the interface.

Keywords – MoS_2, OSCs, Feq_3, F4-TCNQ, Raman, PL, SPEM, XPS