

Interface of Molubedeum Disulfide and Paramagnetic Organic Semiconductor

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Abstract

Transition metal dichalcogenides (TMD) with a layer structure like graphene have attracted tremendous attention because of their superior electronic and optical properties, such as high charge-carrier mobility, tunable charge-carrier types, and high on/off ratio. Based on this, MoS₂-based semiconductor devices have been successfully fabricated recently. On the other hand, organic semiconductors can be easily synthesized via spectacular organic chemical reactions and have advantages, such as low cost, light molecular weight, fabrication in large area, tunability of electronic structure, and compatible with plastic substrates. Due to their low spin-orbital coupling and hyperfine interaction, organic semiconductors have attracted great attention and successfully demonstrated in spintronic devices, named as organic spintronics. In this work, we studied the interplay of these two novel materials for the potential application of spintronics. we deposited paramagnetic OSC, tris(8-hydroxyquinoline)iron(III) (Feq₃), on MoS₂ surface. At the contact of bulk MoS₂/Feq₃ interface, the peaks of Mo 3d and S 2p have a shift 0.1 eV towards higher binding energy (BE). The shifting peaks of Mo 3d and S 2p implied the surface dipole is occurred on the interface of MoS₂/OSCs. In the Raman spectra, bulk MoS₂ atop with Feq₃, two sharp Raman modes, E_{2g}¹ (~383 cm⁻¹) and A_{1g} (~408 cm⁻¹), are observed. The difference of the Raman modes of E_{2g}¹ and A_{1g} represents the number of layers of MoS₂. The distances of E_{2g}¹ and A_{1g} are about 25 cm⁻¹ for all samples which corresponding to the bulk properties of MoS₂. Specially, blue shift of Raman modes was found in single layer MoS₂ atop with Feq₃ that is different with bulk MoS₂ atop with Feq₃. This shift of Raman modes indicated that the charge transfer might occur at the interface of single layer MoS₂ and OSCs.

Keywords – TMDs, MoS₂, Paramagnetic Organic Semiconductors, Iron.