Extrinsic Electronic Structures of Organic Semiconductors Studied by Low Energy UPS and PYS

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Abstract

Information about the bulk and interfacial electronic structures of organic semiconductors is indispensable for understanding and improving organic electronic devices such as organic light emitting diodes, transistors and solar cells. So far, *intrinsic electronic states* such as HOMO and LUMO have been widely investigated mainly by photoemission spectroscopy. Recently, it is recognized that not only intrinsic states but also *extrinsic states* in HOMO-LUMO energy gap (so-called gap states) of organic materials are an essential key to understand practical performance of organic devices. For example, gap states are known to work as trap, and are proposed to induce band bending also: however, the origin and nature of such states are not well understood. Recently, ultraviolet photoemission spectroscopy (UPS) with pure light source was successfully applied to small molecule on graphite to observe gap states [1]. In this study, we have developed a new apparatus to investigate the gap states of various organic samples including small molecular films and polymers by using Low Energy UPS and Photoelectron Yield Spectroscopy (PYS). Low energy light source with double monochromator enables us to investigate very weak levels such as gap state without ghost structure due to stray photon. The several results obtained by this apparatus will be reported on (i) exponentially decaying gap states of rubrene, and deposition-induced morphology change at rubrene/C_{60} interface[2] , (ii) the electronic structure of a typical organic solar cell, ITO/CuPc/C60/BCP/Al system[3], (iii) weak gap states in a wide energy gap of insulating polymers which show tribo-electrification such as polyethylene, nylon, and PET. This research was supported by FIRST Program, G-COE and KAKENHI.

References

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