Charge injection spectroscopy of Alq_3 thin films deposited on the bare and LiF-modified metal substrates.

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Recently, organic light-emitting diodes (OLEDs) have been partly in use as actual display devices, however, the electronic property of the charge-carriers at the interface of metal electrode–organic layer that effects on the efficiency of charge-injection process is not well understood yet.

To evaluate electronic properties of interfacial molecule, charge-injection spectroscopy (CIS or z-V spectroscopy) [1] would be a powerful tool. Since the tip of scanning tunneling microscope used as a charge source penetrates into the organic films until its apex reaches to the organic–metal interfacial region on the CIS measurement, the CIS detects the electronic state of molecules (polaron energy)at the interface in nano-meter scale resolution.

In this study, we investigated local electronic properties of an organic molecule Alq_3 [tris(8-quinolinolate) aluminum] at the electrode interface of various metals by CIS. We found that electron (hole) polaron energies are strongly varied from point to point where we measured but the distribution curves had significant peaks. Secondly, the peak energy values changed depending on the metal work functions. In addition, the polaron energies at metal interfaces are thought to be lowered from that in bulk. We also examined LiF-modified electrode and found that the electron polaron energies at the interface substantially decrease with the LiF thickness increasing in the region of <0.5 nm.

[1] Alvarado et al., IBM J. RES. & DEV. 45, 89 (2001).

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