Modification of Aluminum/Polymer Interface in Organic Light Emitting Diodes by Introducing Ultrathin Organic Oxide Layer: The XPS Study

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Our recent investigation [1] demonstrated the improvement in electroluminescence (EL) efficiency of phenyl-substituted poly (para-phenylene vinylene) copolymer (sy-PPV) based PLEDs using the organic oxide/Al composite cathode. Introducing a thin layer of polyethylene derivative into the cathode interface during the vacuum deposition of Al facilitates the injection of electrons and partly eliminates the metal-induced quenching sites of luminescence in the EL layer close to the recombination zone. This work take on a closer look at the interface chemistry that underlies such processes using high-resolution X-ray photoelectron spectroscopy (HR-XPS).

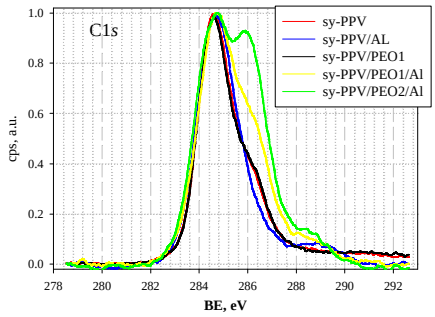

Figure 1. C 1s binding energy analysis with different capping interaction

As clearly presented in Fig. 1, deposition of the Al layer modifies the chemical environment of carbon atoms in sy-PPV polymer (both relative intensity and chemical shifts). This finding is in marked contrast with the results that were published recently by van Gennip *et al.* [2]. Figure 1 also indicates that the deposition of an ultrathin (25 Å) PEO layer on the functional polymer surface (sy-PPV/PEO1 interface) has little or no effect on (the profile of the C1s line. Based on the chemical structures of these polymers (Fig. 1, inset) a variation in the C-C/C-O peak ratios is expected at the least. The absence of changes in XPS spectra can be explained by the very low actual thickness of PEO layer, although its presence in the interface manifests in the EL characteristics of the device. Oxygen-rich PEO reacts with sy-PPV during deposition.

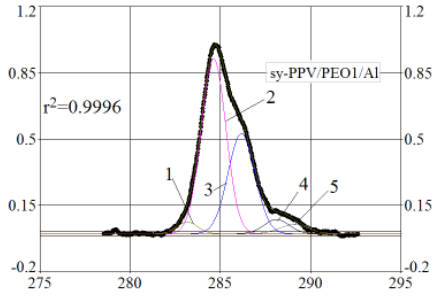

Figure 2. the energy peak resolution of PEO1/Al capping

The situation is different when Al covers the PEO(25Å)-treated surface (Fig. 2). The intensity of the C–O peak remains weakly affected, where as the relative content of the highly oxidized ester-like carbon species is half that of the untreated sy-PPV/Al interface. This result clearly reveals the protective effect of the ultra thin PEO interlayer. The third peak shifts by 0.3 eV toward higher BE, suggesting the possible growing contribution of intrinsic PEO chains, where each carbon atom has its electron neighbor in alternating –O-C-C-O- units. Furthermore, a weak but detectable increase in the relative area under the first peak at 283 eV is observed. The deposition of Al on organic surfaces leads to the appearance of XPS peaks due to heteropolar covalent Al-C bonds or Al-O-C bonds [3,4,].

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