Surface Modification of Metal Oxide Using Ionic Liquid Molecules in Hybrid Organic-Inorganic Optoelectronic Devices

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We demonstrate enhanced device performance by surface modification of n-type ZnO using ionic liquid molecules (ILMs), 1-benzyl-3-methylimidazolium chloride (benmim-Cl), in hybrid organic-inorganic polymeric light-emitting diodes (HyPLEDs) and solar cells (HySCs). HyPLEDs and HySCs were fabricated by sequential deposition of FTO, ZnO, ILMs, poly [phenylvinylene] (super yellow) or poly[3-hexylthiophene] (P3HT), MoO3 and Au layers. Spontaneously aligned dipole polarization within the thin ILMs layer reduces the electron injection barrier, and significantly enhances the electron injection efficiency. The HyPLEDs modified with ILMs show lower turn-on voltage (~ 3.2 V), higher electroluminescence efficiency of 2.7 cd/A (14.0 V), and luminance of 7500 cd/m2 (14.0 V), which electroluminescence efficiency was approximately a forty-fold higher than that of unmodified HyPLEDs. Furthermore, the open-circuit voltage (VOC) of photovoltaic devices was enhanced approximately a two-fold higher due to interfacial modification effect of ZnO layer using ILMs in HySCs.