P2-P028

Design of an Electron Ohmic-Contact to Improve the Balanced Charge Injection in OLEDs

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The n-doping effect by doping metal carbonate into an electron-injecting organic layer can improve the device performance by the balanced carrier injection because an electron ohmic contact between cathode and an electron-transporting layer, for example, a high current density, a high efficiency, a high luminance, and a low power consumption.

In the study, first, we investigated an electron-ohmic property of electron-only device, which has a ITO/Rb_2CO_3-doped C_{60}/Al structure. Second, we examined the I-V-L characteristics of all-ohmic OLEDs, which are glass/ITO/MoO_x-doped NPB (25%, 5 nm)/NPB (63 nm)/Alq_3 (32 nm)/Rb_2CO_3-doped C_{60}(y%, 10 nm)/Al. The MoO_xdoped NPB and Rb_2CO_3-doped fullerene layer were used as the hole-ohmic contact and electron-ohmic contact layer in all-ohmic OLEDs, respectively, Third, the electronic structure of the Rb_2CO_3-doped C_{60}-doped interfaces were investigated by analyzing photoemission properties, such as x-ray photoemission spectroscopy (XPS), Ultraviolet Photoemission spectroscopy (UPS), and Near-edge x-ray absorption fine structure (NEXAFS) spectroscopy, as a doping concentration at the interfaces of Rb_2CO_3-doped fullerene are changed. Finally, the correlation between the device performance in all ohmic devices and the interfacial property of the Rb_2CO_3-doped C_{60} thin film was discussed with an energy band diagram.

Keywords: organic light-emitting diode, ohmic contact, electronic structure, x-ray photoemission spectroscopy, ultraviolet photoemission spectroscopy, near-edge x-ray absorption fine structure spectroscopy