

Improvement of Emitting Properties in Organic Light Emitting Diode having liquid emitting layer

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Recently, we reported a unique OLED based on a neat liquid emitting layer which will open another novel possibility OLED applications¹⁾. It is expected that liquid OLEDs are useful for high reliable flexible display applications because the detachment between a liquid emitting layer and electrodes does not occur in these flexible devices. Further, liquid emitters degraded by the long use of OLEDs can be replaced by fresh organic liquid emitters, resolving the device degradation ascribed to the decomposition of carrier transport materials and emitters. However, liquid OLEDs have serious problems such as low maximum luminance, low efficiency, and high applied voltage.

Here we report improvement of external EL quantum efficiency (EQE), the maximum luminance, and turn-on voltage in the liquid OLEDs. We designed a new liquid OLED structure consisting of a neat liquid semiconducting layer doped with organic salt as an emitting layer and titanium oxide (TiO₂) as a hole blocking layer. A 9-(2-ethylhexyl)carbazole (EHCz) and a tetrabutylammonium hexafluorophosphate were used as a liquid host and an organic salt, respectively. A fabricated liquid OLED structure is indium-tin oxide (ITO)(Anode)/PEDOT:PSS [40 nm]/0.1 wt%-organic salt, 16.7 wt%-guest compound showing green emission, EHCz, [1100 nm]/TiO₂, [10 nm]/ITO(cathode). The driving voltage is decreased drastically and EQE was increased by doping of only 0.1 wt%-organic ionic salt into a neat liquid emitting material even when ITO is used as a cathode. Further, the carrier balance was improved by the insertion of hole blocking layer such as a TiO₂. This novel designed liquid OLEDs showed EQE of 0.4 % and the maximum luminance higher than 100 cd/m², which are 10 times and 100 times higher than a previous report, respectively.

1) D. Xu and C. Adachi, Appl. Phys. Lett. **95**, 053304 (2009).