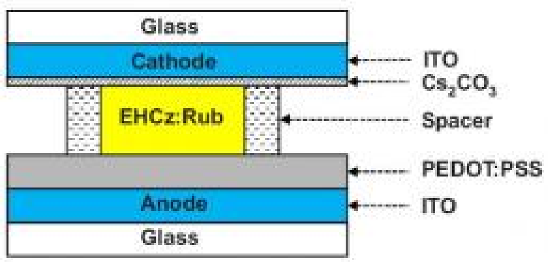
Liquid-OLED Offers More Light-Emitting Possibilities

August 14 2009, By Lisa Zyga



The new liquid-OLED has a liquid semiconducting layer made of EHCz doped with rubrene. Liquid-OLEDs could offer improved device reliability and greater flexibility. Credit: Xu and Adachi.

(PhysOrg.com) -- As organic light-emitting diodes (OLEDs) are poised to go mainstream in the near future, scientists continue to explore new twists on the technology. Recently, researchers have fabricated a "liquid-OLED" - an OLED that uses a liquid organic semiconducting layer to transport charge.

The scientists, Denghui Xu and Chihaya Adachi from the Center for Future Chemistry at Kyushu University in Fukuoka, Japan, have reported the liquid-OLED in a recent issue of *Applied Physics Letters*. As they explain, the novel design is based on a liquid-emitting layer, and could have advantages for flexible displays and other organic electronics applications.

Usually, OLED displays use solid-state organic films that give off light when an electric current is applied. One significant benefit of OLED displays compared to traditional liquid crystal displays (LCDs) is that OLEDs do not require a backlight. For this reason, OLEDs can be made very thin and flexible, as well as use less power, enabling them to run longer on a single battery charge.

The new liquid-OLED could achieve these same benefits, but by using a liquid organic semiconductor instead of the solid-state films. Other than a few previous studies that have investigated using polymer solutions as the semiconducting layer, this is the first time that researchers have attempted to fabricate a practical liquid semiconductor for OLEDs.

As Xu and Adachi explain, their device uses ethylhexyl carbazole (EHCz) as the liquid semiconducting layer due to its high hole mobility, which is associated with good electrical conductivity. The scientists doped the EHCz with solid rubrene, which has a high photoluminescence efficiency. They then prepared a substrate with this liquid mixture placed in between an anode and cathode, which in turn were sandwiched by glass layers. When testing the device, the researchers observed electroluminescence from rubrene with the naked eye.

“Since EHCz provides hole transport and rubrene does electron transport and emitting functions, the combination leads to electroluminescence,” Adachi told PhysOrg.com.

The researchers hope that, by taking advantage of the new device’s unique liquid properties, they can make further improvements in OLED technology. For instance, liquid semiconductors could easily fill the space between two electrodes in curved structures without cracking or shortage problems. The researchers also suggest that the liquid semiconductors could be circulated or refilled into the active emitting layer. This constant, fresh supply of semiconductors could improve device reliability and reduce degradation.

“This is quite a new concept, realizing truly flexible and degradation-free OLEDs,” Adachi said. “Although the electroluminescence efficiency is still low level, we can surely improve it by optimizing the device parameters and organic semiconductors.”

More information: Denghui Xu and Chihaya Adachi. “Organic light-emitting diode with liquid emitting layer.” *Applied Physics Letters* 95, 053304 (2009).