

Hybrid multilayer barrier for flexible OLEDs

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Organic light-emitting diodes (OLEDs) require moisture barrier to protect them from oxidative species such as moisture and oxygen because of the high sensitivity of organic materials and low work-function metals. Recently, the display and lighting markets are moving toward foldable and flexible devices. Flexible thin-film encapsulation (TFE) is considered indispensable for future flexible electronics.

To achieve the flexible moisture barrier film, the best practice is to make the barriers as organic-inorganic multilayer structure shown as Fig.2. The inorganic layers are deposited by atomic layer deposition(ALD) and organic layer is a plasma polymer synthesized with n-hexane monomer using plasma enhanced CVD. The inorganic layers work as moisture barrier and the organic layers provide the flexibility and planarization.

Water vapor transmission rate (WVTR) is a value of the flux of water vapor through a substance under specified conditions. The WVTR values were checked by an electrical and optical Ca test in a climate cabinet under controlled environmental conditions of 85°C and 85% relative humidity.

When the number of interface of Al₂O₃/ZrO₂ was increase, the moisture barrier property was superior to pure Al₂O₃ or ZrO₂. However, nanolaminate structure had lower flexibility because of consisting only inorganic materials. We studied the hybrid multilayer structure of ultra-thin inorganic layers and organic layers to evaluate how much the moisture barrier property could be enhanced. When inorganic layers were divided by a number of ultra-thin(Angstrom-level thickness) inorganic layers which were sandwiched by polymer layers, the barrier property and flexibility were enhanced than the single inorganic layer. We performed bending test of each samples of hybrid multilayer. After bending the sample 10,000 times with a bending radius of 2 cm, 1 cm, 5 mm, and 3 mm, we measured WVTR of bent samples by the electrical calcium test.

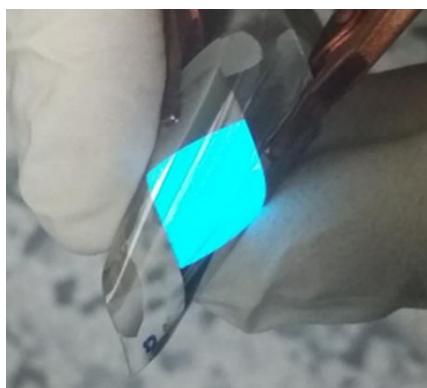


Fig. 1. Flexible OLED device

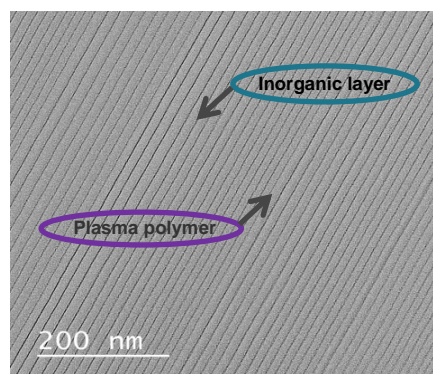


Fig. 2. TEM image of multilayer structure

References

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