Study of Top ITO Electrode Formation for Inverted Top Emission Organic Light Emitting Diode

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Abstract

For mass production of the large sized Active Matrix OLED (AMOLED), the a-Si like TFT array can provide many advantages, including simpler structures, cheaper processes and more uniform transistor characteristics. The a-Si TFT based AMOLED might demand the Inverted Top emission structure for higher efficiency. However, to realize the Inverted Top Emission OLED structure, ITO film deposition for the top anode electrode is one of the most problematic processes in ITOLED device fabrication. Because the sputtering process causes critical damages on underlying organic layers by highly energetic charged particles, UV radiation, and heating-up. To salve the limitations of plasma sputtering process, we are developing the Neutral Beam Assisted (NBA) ITO sputtering system as a plasma damage free process at room temperature. For evaluating the low damage abilities of our NBA ITO sputter, we have developed ITOLED test cells with Al cathode / Liq / Alq3 / NPB / transition metal oxide HIL / test ITO anode structures. While fabricating the test cells, the ITO layers are prepared by normal DC sputtering or NBA sputtering for the purpose the experiments. Base on the results of the OLED test cells, the NBA ITO sputtering system can be verified that inducing almost no damages on the underlying organic semiconducting layers. Also, we have investigated the role of the transition metal oxide HILs (including WO_3, MoO_3 and V_2O_5) as a protection layer against plasma damages during ITO deposition by plasma sputter; after exposure to Ar plasma, the change of electrical / optical properties of the transition metal oxide layer were measured by conductivity, transmittance, and optical band gap. The change of composition structures were also analyzed by XPS. In the case of WO_3 and MoO_3 thin layer, their electrical properties are improved after Ar plasma exposing. However, these thin metal oxide layers with thickness of about 5 nm could not be enough to protect underlying organic layers against plasma attacks.

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