Transparent Electrode Material for Organic Light Emitting Diode by Atomic Layer Deposition

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A modified deposition procedure of zinc-metal dopant-oxygen precursor exposure cycle was demonstrated for better distribution of Al-dopants in ZnO (AZO) films by atomic layer deposition (ALD). It was to reduce the formation of nanolaminate thin films that might form with the typically used alternating ZnO and metal oxide deposition procedure. An introduction of a homogeneous AZO buffer layer showed an improvement of the performance of an organic light-emitting diode (OLED) device fabricated on an AZO anode.

Fluorine-doped ZnO (FZO) thin films by ALD was also investigated with home-made fluorine source at a low deposition temperature. The grain growth orientation was found to change significantly as the fluorine concentration was increased due to the characteristics of fluorine doping in the oxygen sites of ZnO. This phenomenon could be explained by a perturbation and passivation effect resulting from the fluorine doping mechanism, with the fluorine anions filling oxygen-related defect sites in the ZnO lattice. We investigated the effect of F-doping-induced texturing of a ZnO surface to enhance the hole injection properties of an OLED device. Conversely, the work functions of the doped ZnO anodes gradually increased with an increase in surface texturing caused by an increase in the amount of exposed (100) planes. Finally, the best OLED performance was obtained for a ZnO anode containing 0.5 at.% F (the work function value for this film was 4.74 eV) in an OLED device composed of a DNTPD/TAPC/ $Bebq_2$:10%-doped RP-411/Bphen/LiF/Al structure.

References

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