Ultrathin LiF/Al/Ag layer of cathode electrode for highly transparent organic light-emitting diodes

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One of the most attactive advantages of organic light-emitting diodes (OLEDs) is that it can be made transparent devices [1]. The important thing of transparent OLEDs (TOLEDs) is the transparent cathode structures required to high optical transparency and electrical conductivity [2]. To realize this, the study on an ultrathin, smooth silver (Ag) based cathode electrode for high transmittance and low sheet resistance was carried out [2,3,4]. LiF/Al is well known structure of cathode electrode for botom emission OLEDs, and Hung and co-workers reported tansparent LiF/Al/Ag layer with the Ag thickness of 50nm [2]. In this study, we report ultrathin LiF/Al/Ag layer with a Ag thickness ranging from 4~10 nm for highly transparent cathode electrode. Fig. 1 (a) shows obvious difference between the sample with Al/Ag structrues and the Ag only structures. In the Al/Ag structures, charge density oscillations confined to metallic nanoparticles disappeared. The scanning electron microscopy (SEM) images shows that the Al/Ag layer have more smooth and continuous surface morphology compared to the the Ag layer as shown in Fig. 1 (b). As well known growth mode of Volmerï Weber, the Ag thin film tend to initially form isolated islandsons on dielectric surfaces [5]. From the measurement of optical transmittance and SEM images, we concluded that the insertion of Al layer minimize the strong localized surface plasmon absorption, this leads the improvement of transmittance.

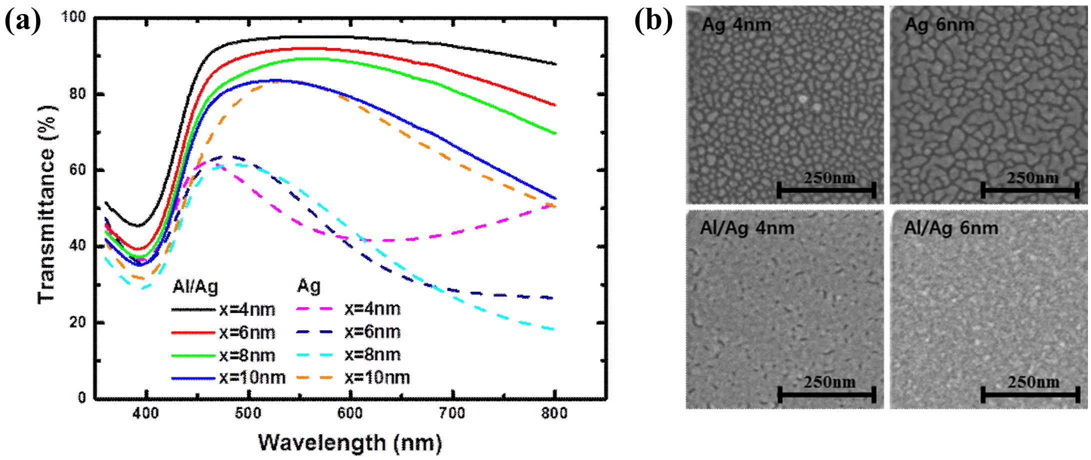

Fig. 1. (a) Optical transmittance spectra of the Glass/Alq3(60nm)/LiF(1nm)/Al(1nm)/Ag(x)/Alq3(60nm) (solid line) and Glass/Alq3(60nm)/LiF(1nm)/Ag(x)/Alq3(60nm) (dotted line) as the thickness of the Ag layer. (b) SEM images of the Ag and Al/Ag surfaces at the sample with the Ag thickness of 4, 6nm.

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