An embossing structure improving viewing angle and device efficiency characteristics of organic light emitting diode

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Conventional organic light emitting diode (OLED) has an intrinsic limitation that only ~20% of light can be escaped to air due to various light confinement mechanisms [1-2]. The limitation induces energy loss and device lifetime problem. Besides, viewing angle distortion problem results from microcavity effect has to be overcome. We have fabricated an embossing structure which can resolve the viewing angle distortion and light confinement problems. The embossing structure was attached on the glass substrate of a green phosphorescence OLED. In order to investigate the influence of microcavity, the thickness of electron transport layer (ETL) was varied 30nm and 60nm. Fig. 1-(a) and (b) show the scanning electron microscope (SEM) and atomic force microscope (AFM) images of the structure. The integrated external quantum efficiency (EQE) of the planar OLED was 12.9% for 60nm ETL and 20.1% for 30nm ETL. The enhancement of OLED with the embossing structure was 40.7% for 60nm ETL and 30.1% for 30nm ETL. Difference of EQE by ETL thickness is due to microcavity effect. For 30nm of ETL, optical length of devices was optimized to obtain high EQE. For 30nm thickness, more enhancement of EQE has been obtained instead viewing angle distortion appeared. By applying the embossing structure, we obtained the stabilized viewing angle characteristic as well as the enhanced EQE. The simple embossing structure can be applied portably to various optical applications in the aspect of enhancing efficiency and spectrum stabilization.

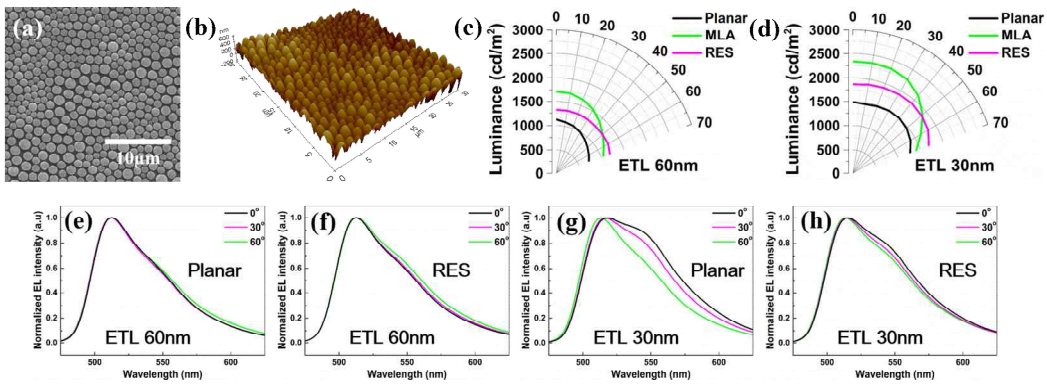

Fig. 1. (a) SEM and (b) AFM image of embossing structure, luminance distribution of (c) ETL 60nm and (d) ETL 30nm devices, viewing angle characteristics of (e), (f) ETL 60nm and (g), (h) ETL 30nm devices.

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References

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