Pixelated Graphene Electrodes for OLED Display

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Graphene has been suggesting a great potential in various applications such as electronics, photonics, sensors, and so on. Among them, one promising application close to commercialization is transparent electrodes in optoelectronic devices due to its superior flexibility and high transmittance. [1-2] In particular, in laboratory-scale demonstrations, graphene based organic light-emitting diodes (OLEDs) already shown optical and electrical properties comparable to ITO based ones. However, graphene may be currently regarded as a component, which has to be integrated into modules and systems. Fundamental properties of transparent electrodes like high transmittance, low sheet resistance, and low surface roughness are preferentially confirmed. To realize commercialized graphene OLED display, more practical issues should be concerned; graphene layer should has conformal contact on a non-planar surface, low contact resistance with via contact, and chemical stability and high adhesion strength during a patterning process. Moreover, large scalability and uniformity with low defect density are also important issues considering a productivity increase. [3]
In this talk, basic optical and electrical graphene OLED characteristics fabricated in our research group firstly discussed compared with ITO based OLEDs. Due to the graphene absorption, multi-layered graphene based OLEDs exhibits theoretically lower efficiency than ITO based ones, but single or two-layered graphene can achieve comparable OLED efficiency with stable angular emission properties. Then, we present and discuss aforementioned technical issues to fabricate a graphene OLED display panel. On a 100 mm X 100 mm sized glass substrate imitating a display backplane, which has bus line electrodes, via holes, and via contacts, the OLED panel with the graphene pixelated electrodes has been successfully demonstrated as shown in the figure 1. The panel integrated the pixel array of about 80 X 410 with a pixel density of 121 pixel-per-inch.

References

[1] J. T. Lim et al., Sci. Rep., 5 (2015) 17748
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[3] J. Moon et al., Diamond and related materials, 57 (2015) 68-73

Figures

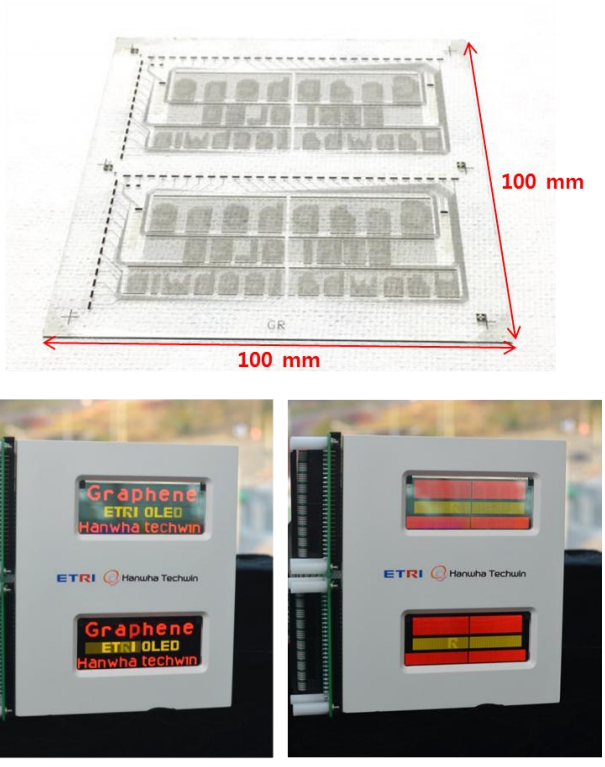

Figure 1: Pixelated graphene electrodes on the glass substrate imitating a display backplane and actual operating images of OLED panel based on it.