Stable and foldable composite circuits on paper for organic light emitting diodes

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Foldable and flexible electronics are a promising issue for the convenient transportation and diverse deployment of organic-based large area electronics as well as disposable thin film devices. In this paper, we fabricated the graphene/ silver nanowires composite electrode on the paper substrates for the interconnection electrode of top emission organic light emitting diode (TOLED).

Poly(4-vinylphenol) (PVP) was spun coated on the commercial papers as a planarization layer, that was useful for reduction of surface roughness toward OLED device fabrication. The composite electrode of silver nanowires and graphene was formed on the planarized paper substrate with variable fraction of graphene. Fig.1-a shows that silver nanowire acts as binders in graphene flake. Sheet resistance of composite electrode maintains that until 30wt% graphene composite electrode shows good conductivity. It was confirmed that stability of electrode against 1000 cycles folding test was obtained with a -180 ^{o} ~ +180^{o} folding angles, showing the possibility of its application as foldable electrodes. Top emitting OLED was prepared by thermal evaporation on paper, with Al/ molybdenum oxide (MoO3)/ N,N-di(naphthalene-1-yl)-N,N-diphenyl-benzidine (NPB)/ Tris-(8-hydroxy-quinoline)aluminum (Alq3) / LiF/ Al/ Ag. Fig.1-b shows the maximum luminous efficiency of TOLED against 100 cycles folding test. The increase of graphene component in composite electrode improves the stability of folding circuits. Our approach will be a facile and cost-effective strategy for foldable and flexible OLEDs toward application such as disposable electronics and digital signage.

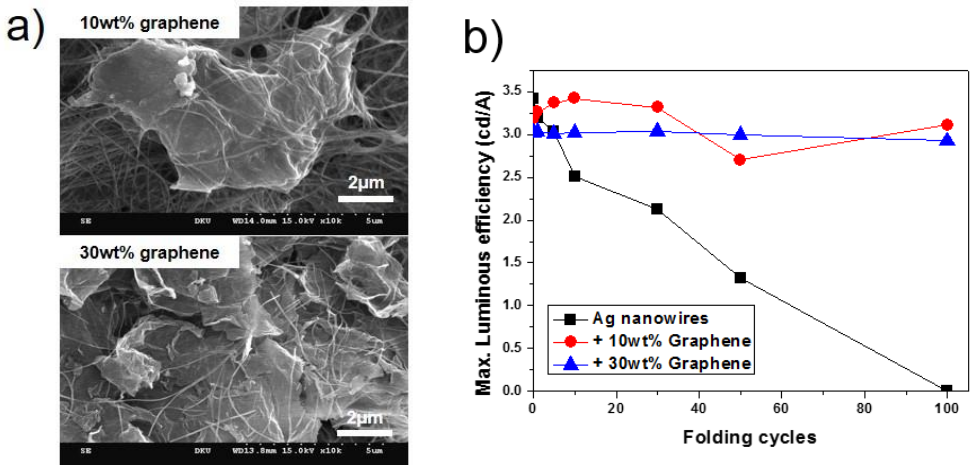

Fig. 1. SEM image of graphene/silver nanowires composite electrode and Max. luminous efficiency of TOLED by folding cycles (+180^{o} folding angle).

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