# Highly Efficient Flexible Organic Light Emitting Diodes Based on Graphene Transparent Conductive Electrodes

**Jinhong Du**
Dingdong Zhang, Wencai Ren, Hui-Ming Cheng

*Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, 72 Wenhua Road, Shenyang 110016, China*

jhdu@imr.ac.cn

Abstract

High-quality graphene grown by chemical vapour deposition has a great potential as transparent conductive electrodes (TCEs) for high-performance flexible organic light emitting diodes (OLEDs), due to its high electrical conductivity, high optical transparency, excellent mechanical flexibility, and good chemical stability. However, the large surface roughness generated during transfer process, mismatch of the work function and poor interfacial compatibility seriously limit its application. Here, a rosin-assisted wet etching transfer method is developed to fabricate ultra-clean and damage-free graphene TCEs with a very low surface roughness over a large area (Figure 1).[1] On the one hand, a graphene oxide/graphene (GO/G) vertical heterostructure transparent anode is designed to achieve a large work function and good compatibility with MoOx hole injection layer for conventional OLED.[2] On the other hand, polyethylenimine ethoxylated is used to reduce the work function and improve the compatibility of graphene transparent cathode with electron injection layer for inverted OLED. The clean surface, good work function matching and compatibility of graphene TCE greatly improve the device performance. The maximum current efficiency and power efficiency can reach 89.7 cd $A^{-1}$ and 102.6 lm $W^{-1}$ for conventional OLED, and 66.0 cd $A^{-1}$ and 57.4 lm $W^{-1}$ for inverted OLED, which are much better than those based on ITO TCEs. More importantly, a 4-inch flexible green OLED with uniform light emitting and high luminance (ca. 10000 cd $m^{-2}$ at 16 V) has been successfully fabricated.[1]

References

[1] Zhang, Z. K.; Du, J. H.; Zhang, D. D.; Sun, H. D.; Yin, L. C.; Ma, L. P.; Chen, J. S.; Ma, D. G.; Cheng, H. M.; Ren, W. C., Nat Commun., 8 (2017) 14560.

[2] Jia, S.; Sun, H. D.; Du, J. H.; Zhang, Z. K.; Zhang, D. D.; Ma, L. P.; Chen, J. S.; Ma, D. G.; Cheng, H. M.; Ren, W. C., Nanoscale, , 8 (2016), 10714-23.

Figures

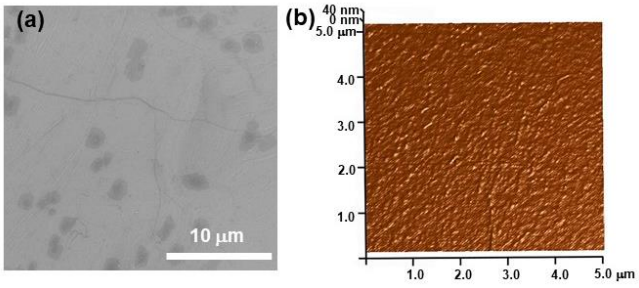


**Figure 1.** The transferred graphene TCE by a rosin-assisted wet etching method. (a) SEM and (b) AFM images of graphene transferred on $SiO_2$/Si substrate.