Graphene Electrodes for Flexible Organic Electronics

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Abstract

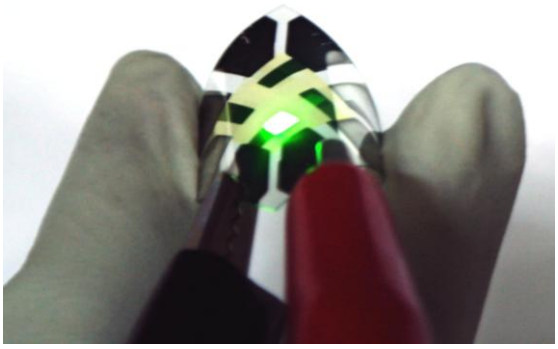
Graphene films have a strong potential to replace indium tin oxide anodes in various organic electronic devices such as organic light-emitting diodes (OLEDs), organic photovoltaic cells (OPVs) and organic thin-film transistors (OTFTs) to date. Most of all, in OLEDs device, however, the luminous efficiency with graphene anodes has been limited by a lack of efficient methods to improve the low work function and reduce the sheet resistance of graphene films to the levels required for electrodes. Here, we fabricate flexible OLEDs by modifying the graphene anode to have a high work function and low sheet resistance, and thus achieve extremely high luminous power efficiencies (37.2 lm/W in fluorescent OLEDs, 102.7 lm/W in phosphorescent OLEDs), which are significantly higher than those of optimized devices with an indium tin oxide anode (24.1 lm/W in fluorescent OLEDs, 85.6 lm/W in phosphorescent OLEDs). We also fabricate flexible white OLED lighting devices using the graphene anode. These remarkable device efficiencies increase the feasibility of using graphene anodes to make extremely high-performance flexible organic optoelectronic devices by overcoming the major drawbacks (low work function and trap formation due to diffusion of indium and tin) of conventional ITO anodes. These results demonstrate the great potential of graphene anodes for use in a wide variety of high-performance flexible organic optoelectronics such as flexible, stretchable full-colour displays and solid-state lighting. In addition to the OLED application, we will demonstrate OPVs and OTFTs using graphene electrodes.

References

[1] T.-H. Han, Y. Lee, M.-R. Choi, S.-H. Woo, S.-H. Bae, B. H. Hong, J.-H. Ahn and T.-W. Lee, Nature Photon. **6** (2012), 105-110..

Figures

(a)



(b)

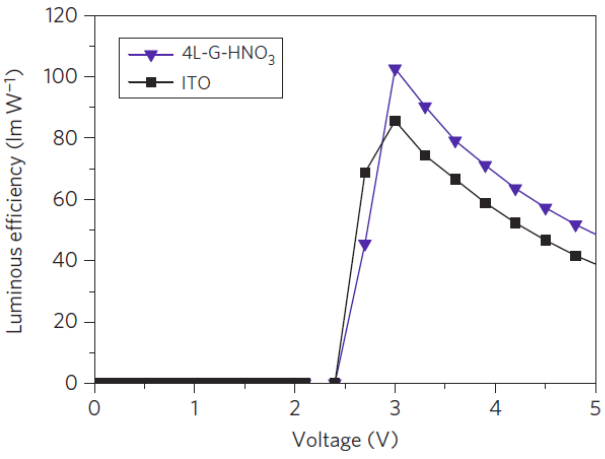


Figure 1. Flexible OLEDs using graphene anode. (a) Optical images of light emission from a flexible green OLED with a four-layered graphene anode doped with HNO_3 (b) Performance of phosphorescent OLEDs with four-layered graphene and ITO anodes