Mass-producible graphene replacing Indium Tin-Oxide in OLEDs

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Organic Light-Emitting Diodes (OLEDs) have become the booming technology in the display industry, including TVs, smart phones, tablets, etc., and Indium tin oxide (ITO) is widely used for transparent electrode applications in OLEDs due to its high electrical conductivity and relatively straightforward deposition technology. However, Indium is one of nine rarest elements on Earth and there's limited availability of Indium in the Earth's crust, making the future OLED technology non-sustainable. Graphene, the fully carbon-based 2D material, is considered as a promising material for replacing ITO but for this to become possible, a low-cost and scalable fabrication method that produces graphene with comparable performance to ITO is required. By taking advantage of high-quality monolayer graphene directly deposited on a transparent substrate using a commercially available metal–organic chemical vapor deposition (MOCVD) system at Paragraf™, graphene-based organic light-emitting diodes (OLEDs) without the use of metal catalysts or a graphene transfer process are developed. The as-grown graphene is patterned using photolithography and its conductivity is enhanced by doping with nitric acid prior to deposition of the OLED stack. The electrical and optical performances of the as-fabricated graphene-based OLEDs are identical to the control devices with conventional ITO anodes. All the processes used in the fabrication of graphene-based OLEDs can be performed at wafer scale. This work demonstrates the potential for graphene to replace ITO as anodes in OLED devices in a technologically and commercially effective manner for the future display applications.