Tuning work function values in graphene oxide – derived films

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Abstract

Work function (WF) is a fundamental electronic property of any material and provides understanding of the relative position of the Fermi surface level. WF tuning of the contact electrodes is a key requirement in several device technologies, including organic photovoltaics (OPVs), organic light-emitting diodes (OLEDs), and complementary metal oxide semiconductor (CMOS) transistors [1]. Work function of graphene and its derivatives and the ability to control its value is a very important factor in applying these as an electrode material. Very recently, interest in a thin film of graphene oxide (GO) and reduced GO as an efficient hole transporting layer (HTL) for high-performance polymer solar cells (PSCs) has been emerged [2].

The aim of this work is to correlate the absolute WF value with the oxygen functionalities in a thin GO and rGO films. The GO film was deposited on ITO substrate, reduced with thermal treatment (heating in ultra high vacuum), chemical treatment or a combination of chemical and thermal process in vacuum. In order to investigate the effect of GO synthetic strategy , two different GO synthetic protocols which lead to differences in flake size and oxygen content were investigated. Additionally, the effect of GO thickness was also investigated. In order to correlate the WF with oxygen content and oxygen functionalities, X-ray and Ultraviolet Photoelectron Spectroscopies (XPS/UPS) used in each reduction step.

The results showed that, as the oxygen content decreases upon thermal reduction of GO/ITO films, the work function decreases up to ~1eV. The combination of both chemical and subsequent thermal reduction leads to reduction of WF at even lower values depending on the presence of heteroatoms on the surface.

References

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