Non-covalent Functionalization of Graphene with Fe-/Co-porphyrin and Fe-phthalocyanine and its Effect on Field Effect Transistors Characteristics

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Graphene has attracted considerable attention in many areas of nanoscience and nanotechnology due to its exceptional electrical, mechanical, and chemical properties [1-2]. However, graphene is a semimetal with zero band gap. This character limit its use in some applications that exploit its semiconducting behavior. Chemical modification of graphene sheets with small organic molecules represents a viable approach for tailoring electronic properties such as band gap opening, majority carrier type, and improving its dispersing ability and compatibility. In this study, graphene was synthesized by Chemical Vapor Deposition (CVD) and functionalized with Fe-/Co-porphyrin and Fe-phthalocyanine through π-π interactions. The resulting nano-hybrid materials were characterized by Raman spectroscopy, X-ray photoelectron spectroscopy, scanning electron microscopy, and high-angle annular dark-field scanning, transmission electron microscopy techniques. The presence of Fe-/Co-porphyrin and Fe-phthalocyanine molecules in the nano-hybrid materials was evidenced by spectroscopic and microscopic analysis, which confirm that these molecules were immobilized on the surface of graphene through electrostatic and π-π stacking. The Raman spectroscopy confirmed that the n- or p- doping of graphene according to their chemical nature. The electrical characteristics of graphene field-effect transistors (GFETs) based on nano-hybrid materials were subsequently evaluated and demonstrated a charge transfer between the physisorbed molecules and the graphene. All these results suggest that the electronic structure of graphene can be tailored by doping with aromatic molecules.

References

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