Graphene Reinforced With Polypyrrole Nanoparticles For Energy Storage Application

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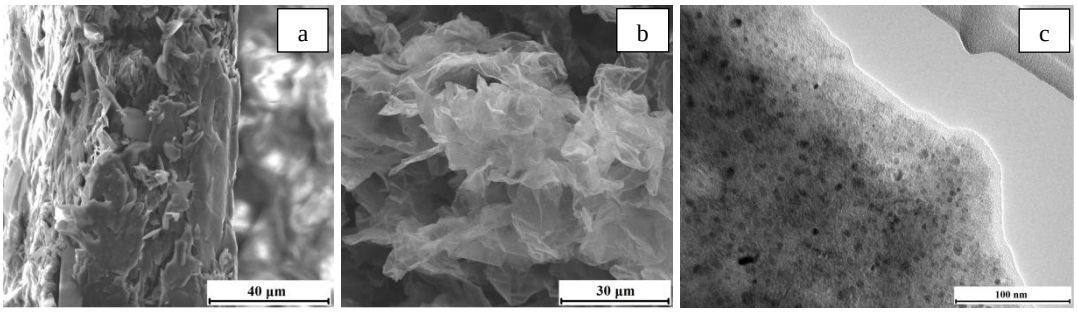
Abstract

A binary nanocomposite film comprising polypyrrole (PPy) nanoparticles decorated graphene was realized using an Fe(III)-assisted electrochemical deposition approach. In the absence of Fe(III), graphene sheets were completely enveloped by PPy. With the inclusion of Fe(III) as a catalyst, the growth of PPy was controlled, which resulted in nano-sized PPy embedded uniformly on the surface of graphene sheets. The PPy nanoparticles act as spacer to hinder the π-π stacking of neighbouring graphene sheets, causing the random orientation of the graphene sheets that gives rise to a highly porous structure. Without Fe(III), the nanocomposite film consists of largely PPy, indicating continuous growth of pyrrole monomers on the existing PPy during electrodeposition. In contrast, the PPy matrix was replaced with PPy nanoparticles in the presence of Fe(III) during electrodeposition, which suggests that Fe(III) encouraged the nucleation of PPy on the graphene sheets. The unique porous three-dimensional structure is likely to find application as an electrode material for energy storage application.

Figures



FESEM images showing cross sectional views of graphene/PPy prepared (a) in the absence and (b) in the presence of Fe(III). TEM image shows decoration of graphene with PPy nanoparticles.