Hydrostatic bath synthesis of conductive polypyrrole/reduced graphene oxide aerogel as compression sensor

ABSTRACT

A conductive and elastic polypyrrole/reduced graphene oxide aerogel (PGA) was synthesized through a hydrostatic bath method followed by freeze-drying. Through this method, the self-agglomeration and oxidative polymerization of rGO and polypyrrole occurred synergistically in a controlled environment, which resulted in a 3D conductive aerogel matrix. The optical spectroscopy, including FT-IR and XPS, showed the distinguished vibration band of polypyrrole and π-π interaction, which evidenced the successful polymerization of the pyrrole monomer through the synergistic assembly process. The presence of flexible rGO nanosheets as an aerogel backbone provided a strong mechanical support and deposition sites for polypyrrole nanoparticles, which contributed to the overall elasticity. Furthermore, the polypyrrole nanoparticles not only addressed the stacking issue of rGO but further enhanced the reactive surface area by eight times of magnitude compared to pure graphene aerogel (GA) produced by the same technique. Molecular modeling estimates adsorption energies for the polypyrrole molecule over the rGO surface and further predict the dominant functional group that involve in the formation of PGA. The as-synthesized PGA provide a significant electrical resistance changes (>80%) before and after compression, which responded exceptionally well upon compression by lighting up LEDs that were arranged in parallel in an electrical circuit.

Keyword: Hydrostatic bath synthesis; Aerogel; Graphene; Polypyrrole