

Facile synthesis of rGO doped transition metal oxide nanostructured materials for high energy/power density supercapacitor applications

Introduction

Gradual exhaustion of fossil fuel as well as the increase of CO₂ emissions has been arousing the search and development of renewable energy sources, such as solar, wind, ocean and biomass. To use such energy sources efficiently, high energy/power and long-lifetime energy storage devices are generally required. Meanwhile, future extensive popularization of electric vehicles, smart grids, and various portable and wearable electronics also stimulates the demand for high-performance energy storage devices. The current lithium-ion batteries were having ability to store large amount of energy ($>100 \text{ W h kg}^{-1}$) via bulk redox reactions in electrodes, it has already been widely used in portable electronics such as laptops, smartphones and electric vehicles. Nevertheless, low power density of lithium-ion batteries cannot simply meet the requirements for acceleration, braking, and climbing of electric vehicles.

On other hand, EDLC type supercapacitors have the ability to provide much more power density than lithium-ion batteries. The high cost of the carbon derivatives used in the conventional EDLC supercapacitors and its poor energy density are the key issues in some commercial applications. To felicitate this, researchers focusses on metal oxide based pseudocapacitors due to their high energy density. The common metal oxides such as NiO, MnO₂, V₂O₅, Co₃O₄, RuO₂ and TiO₂ etc., are used in pseudocapacitors. But power density of these metal oxide pseudocapacitors were very low. To overcome this issue, researchers were working on nanostructured carbon derivatives (rGO, CNT, g-C₃N₄) doped metal oxide nanocomposites for high power/energy density supercapacitors.

Research work plans

- Hydrothermal synthesis of rGO doped MnO₂/NiO hierarchical nanostructures for high performance supercapacitor applications.
- Decoration of high energy density LiCoO₂ on functionalized CNT for high energy/power density supercapacitor applications.

- Synthesis of rGO doped RuO₂/MnO₂ nanocomposite for hybrid supercapacitor applications.

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