
Graphene / MnO₂ Synthesis and Electrochemical Nanocomposites

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Abstract

In recent years, in order to reduce the use of fossil fuels and the negative impact on the environment and the climate, people began to seek to develop new sustainable or renewable energy sources such as solar and wind. Because of wind, hydro and solar energy, these renewable energy output (such as voltage, current) is not a constant value, affected by external circumstances. To more effectively take advantage of these electric energy needs with the use of large-capacity storage system, namely electrochemical capacitors such as an electrochemical super capacitor energy storage system and caused widespread attention. Super capacitor energy density, high energy can be stored, is a method of energy storage now emerged applications.

Keywords

graphene manganese oxide electrode, manganese dioxide, holey structure graphene

1. Instruction

Super-capacitor electrode material attracted many researchers' attention, since 2004 Geim first release graphene used as clean energy devices studies[1]. Capacitor energy storage methods are generally two types of non-Faraday process, charge separation is based on the electrode and electrolyte interface; the other is the Faraday process, dependent on the redox generated on the electrode material, super capacitors basic principle. Compared with the conventional capacitor having replaced many metal porous structure of the porous electrode, and therefore more super-capacitors and at the same time has a structure similar to a conventional capacitor, super-capacitor can store energy density.

The most common super-capacitor electrode active material is a carbon material, a conductive polymer and a transition metal oxide. Selection of the main requirements of the active material a material having high reversible capacitance, structural flexibility and stability, rapid diffusion can cationic charge and discharge at high rates, and friendly to the environment. These electrode materials, the manganese oxide compounds having a relatively high specific capacitance, its resource-rich, low cost and environmentally friendly, in terms of active electrode materials for use as super-capacitors attracted a lot of attention of researchers. Because of its large number of different crystalline defects in different locations, different morphologies and different pore structure, manganese oxide compounds can exhibit a wide variety of significant electrochemical properties. When manganese oxides used as an electrode material, these structural factors play a key role in determining and optimizing the electrochemical properties [1]. Manganese oxide compounds affect capacitor performance in the expanded study based on an effective basis for the design and improvement of electrode material[2]. However, the transition metal oxide used in the super-capacitor electrode is still subject to many restrictions, such as low conductivity limits the fast transfer of electrons resulting in a lower energy density in the redox processes in the material structure can easily be destroyed so that the capacitor loop poor stability. To solve these problems a carbon material having high conductivity and large specific surface area is often used as an electrode active material supercapacitor support material.

Given the many advantages of graphene has a high electrical conductivity and high mechanical strength, graphene is considered the most suitable super capacitor electrode base material was prepared.

2. Method

Most of the current study, the preparation method is based on the use of potassium permanganate as raw material, using a simple method of reducing the original heating, manganese dioxide nanoparticles deposited on the surface of graphene DMF reduction was obtained graphene composite nanostructures[3].

As shown in FIG. 1, the graphene oxide surface with a chemical group has a lot, such as a carboxyl group, a hydroxyl group, a carbonyl group and the like, the presence of these groups, such that between the graphene oxide repel each other forming a single layer structure. The graphene oxide dispersion was dissolved in DMF and then reacted by heating. DMF in the heating process will be decomposed diethylamine and carbon monoxide, the carbon monoxide which can be carboxyl, hydroxyl, carbonyl reduction, the reduction of carbon-carbon bonds of carbon-oxygen bonds of these groups. Meanwhile DMF produced during the decomposition of diethylamine adsorbed on the surface and edges of graphene, such graphene surfaces and edges with a certain amino group. Amino presence makes graphene can continue to repel each other and stable. Potassium permanganate was added to the reaction continued to promote the decomposition by heating potassium permanganate, potassium permanganate, manganese dioxide decomposition Low precipitate, which precipitate was adsorbed on the surface of the graphene to form a graphite obtained dilute / MnO₂ Nanocomposites[1].

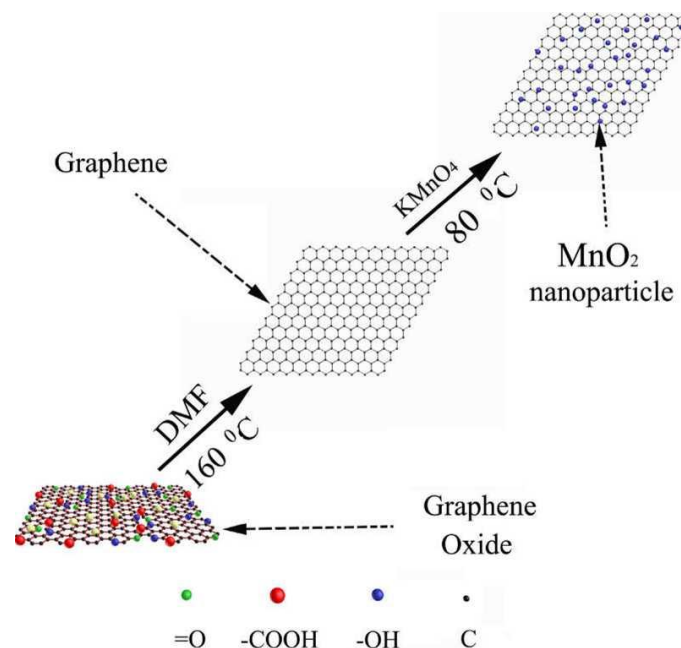


Figure1 schematic diagram of the synthesis of graphene / MnO₂

3. Result

Nanocomposites Investigation by adding potassium permanganate in situ synthesis of graphene graphene solution / manganese dioxide nano composite material is used as electrode materials for supercapacitor electrochemical properties, main results were as follows:

Use N, N- dimethylformamide as a solvent of DMF solution containing graphene added potassium permanganate and heated in situ synthesized graphene / manganese dioxide composite nanomaterials. The sheet material from a single layer of graphene and graphene sheets dispersed in the layer

constituting the manganese dioxide nanoparticles, the size of manganese dioxide measured nanoparticles about 30 nm;

Investigation graphene / manganese dioxide electrochemical storage performance composite nanomaterials mainly by comparing the cyclic voltammetry curves under varying circumstances scanning speed Yeah, but that nanocomposites have a good capacitive nature [2];

At a fixed charge current of the nanocomposite do constant current charge-discharge test, that the material has good electrical conductivity and less internal resistance; in different charging current constant current charging and discharging the material to do experiments, the result showed that the capacitor electrode has better features and better electrochemical reversibility [3].

4. Discussion

Using a very simple method to make the heating MnO₂ nanoparticles decomposition of potassium permanganate, and manganese dioxide particles deposited on the surface of the graphene give graphene nano comply with manganese dioxide material, by AFM, TEM, SEM, XPS and other testing methods to determine the synthesis of both compliance with nanostructures. Will meet nanostructures immobilized on glassy carbon electrode surface by examining different scan rate of cyclic voltammetry, constant current charging different charge and discharge curve, a constant current charge and discharge curve found that compliance with the conductive material is better, having good electrochemical reversibility, it can be used as an electrochemical storage material. Should graphene / MnO₂ comply nanomaterials assembled into capacitor device, using symmetric capacitor electrode test, which can be more accurate, more comprehensive testing such a capacitor performance [2].

5. Conclusion

Use of graphene with potassium permanganate simple mixing heating DMF reduction can be obtained graphene/ MnO₂ Nanocomposites. By AFM, test results TEM, XPS showed that graphene and MnO₂ good combination. In Na₂S₄O₆ electrolytes studied this composite material as a capacitor electrode material of electrochemical storage performance. The results show that the material exhibits excellent electrochemical storage capacity, can be used as a capacitor electrode material.

Reference

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