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Preparation and Properties of Supercapacitor Based on Conducting Polyaniline/Graphene Oxide Nanocomposites

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INTRODUCTION & AIM

Everything on Earth needs energy, from living things to our daily lives to Earth's changes. The world faces global warming and energy shortages. Thus, solar and wind power, which are becoming more popular due to their renewable energy, are essential. Renewable energy requires energy storage for use when there is no sunlight or wind. Due to industrial and technological advancements and population growth, energy demand is rising rapidly. Thus, electrical energy storage devices will become more important. Batteries and capacitors store this energy.

Supercapacitors, a highly coveted energy storage technology, are distinguished by their elevated capacitance and swift charging and discharging capabilities. A notable characteristic of supercapacitors is their capacity for repeated charging and discharging, along with their resilience to temperature fluctuations, shock, and vibration. Common materials employed in supercapacitors comprise metal oxides, conductive polymers, and high surface area substances, which can prolong the lifespan of energy storage devices and improve their efficiency.

The primary objective of this research is to enhance the performance of supercapacitors. Graphene Oxide (GO), a material with a high surface area, is combined with the conductive polymer polyaniline (PANI). The material is subsequently applied to fluorine-doped tin oxide (FTO) glass to augment its electrical conductivity. This study initiates with the synthesis of polyaniline-graphene oxide utilizing a defined reaction duration and concentration. GO to augment the charge storage capacity of supercapacitors.

METHOD

1. Preparation of GO

1 g graphite powder and 0.5 g sodium nitrate were mixed. After 2 hours in an ice bath, 25 ml of sulfuric acid and 3 g of potassium permanganate were slowly added. Then 10 ml 30% hydrogen peroxide was added. Agitated 500 ml deionized water was added. Yellow-brown GO was found. After centrifuging, the GO was washed several times with deionized water and 50% methanol until pH was neutral. The GO was air-dried.

2. Preparation of PANI/GO Nanocomposites

15, 30, and 45 mg of GO were dispersed in 30 mL of deionized water for 30 minutes. Incorporate 51.3 mg of ammonium sulfate (APS) and ensure thorough mixing. Subsequently, incorporate 0.031 ml of aniline ($C_6H_5NH_2$) and an equivalent molar amount of hydrochloric acid (HCl), and thoroughly mix for 15 minutes. The mixture underwent sonication for 30, 45, 60, and 75 minutes at 50 °C, with a 10-second on-off cycle and 25% amplitude. The collected samples were subsequently subjected to centrifugation and dried at 60 °C for 48 hours to evaluate the optimal duration and quantity of GO that yielded the most favorable charge storage characteristics.

RESULTS & DISCUSSION

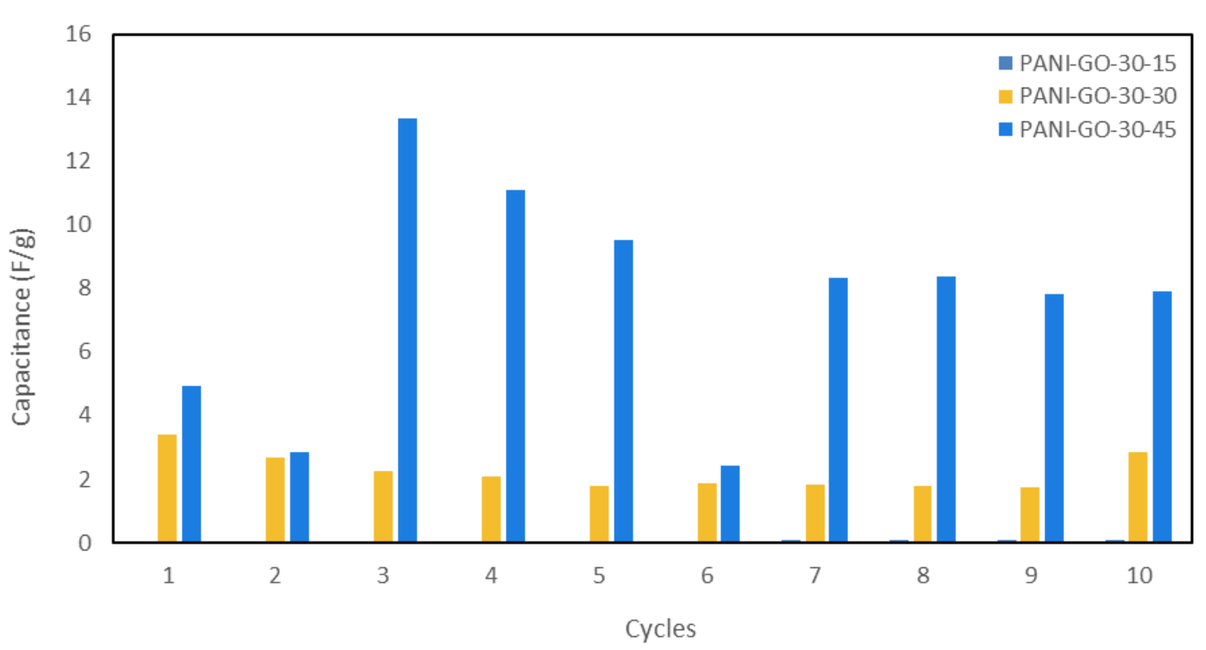

Fig. 1 The correlation between the number of test cycles and the specific charge storage values at 15, 30, and 45 mg of GO content.

CONCLUSION

The experimental findings indicated that a reaction duration of 30 minutes, combined with a weight ratio of aniline (ANI) monomer to GO at 1:1.5, provided a perfect specific capacitance value of 13.30 F/g. The powerful electrochemical performance of the PANI/GO electrode might result from the enhanced active sites for PANI deposition, related to the large surface areas of GO. The outcomes highlighted the significance and remarkable potential of GO in advancing high-performance supercapacitors using PANI.