زانکۆی پۆلیتەکنیکی هەولێر
بەڕێوەبەرایەتی دڵنیایی جۆریی

فۆرمی هەژمارکردنی خاڵی کارا و ناکارا لە سیمینار

سەبارەت بە هەژمارکردنی خاڵەکانی پێشکەشکردن و ئامادەبوونی مامۆستا لە سیمینارەکانی بەش و کۆلێژ و دەرەوەی زانکۆ بۆ ساڵی ئەکادیمی 2022-2023 بەم شێوەیەی خوارەوەیە:

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زانکۆی پۆلیتەکنیکی هەولێر
دڵنیایی جۆری و پرۆگرامەکانی خوێندن
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Article

Effect of Graphene Oxide and Temperature on Electrochemical Polymerization of Pyrrole and Its Stability Performance in a Novel Eutectic Solvent (Choline Chloride−Phenol) for Supercapacitor Applications

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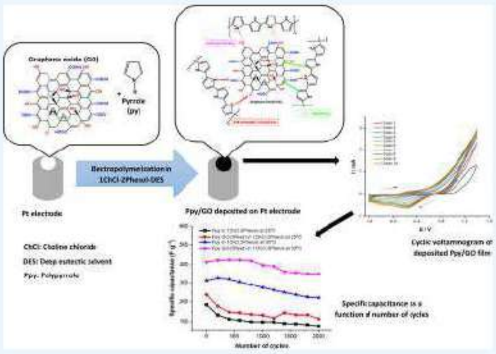
ABSTRACT: Polypyrrole (Ppy)-modified graphene oxide (GO) electrodes were synthesized for the first time in a choline chloride−phenol-based deep eutectic solvent at various temperatures via electrochemical methods without the addition of any inorganic or organic catalysts. The surface morphologies and structures of the modified films were assessed via scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, and X-ray diffraction techniques. The electrochemical properties and stability of the modified electrodes were investigated via cyclic voltammetry and impedance spectroscopy at various temperatures and scan rates. The results showed that the specific capacitance of the nanocomposites decreased with increasing scan rate during cycling. Additionally, the specific capacitances of the pure Ppy and Ppy/GO films increased with increasing temperature of the electrolyte (monomer-free), attributed to the reduction in viscosity at elevated temperature. The specific capacitances at 5 mV s^{-1} were found to be 1071.78 and 594.79 F g^{-1} for Ppy/GO (20 wt %) at 50 and 25 °C, respectively. It was also observed that the resistance in the cell decreased with increasing electrolyte temperature. Ppy/GO at 50 mV s^{-1} was found to have the highest capacitance retention of 85% after 2000 cycles, showing better cycling stability than the pure Ppy film. Herein, the incorporation of GO in the Ppy matrix led to improved specific capacitance and cyclic stability, suggesting that Ppy/GO could represent a promising electrode material for supercapacitor applications.



1. INTRODUCTION

Supercapacitors are a promising energy storage system for sustainable energy management due to their intrinsic properties, such as good cycle performance and reversibility, safety in operation, and high-power capability, ensuring that they have received a vast amount of attention.[1,2] The mechanism of charge storage in supercapacitors is classified into two categories: (i) pseudocapacitors (such as conducting polymers and metal oxides) and (ii) electronic double-layer capacitors (EDLCs) (such as carbonaceous materials). The charge storage efficiency in a pseudocapacitor is a result of chemical reactions based on the Faradaic process that take place through an activated substance component of the electrodes, while the efficiency of EDLCs (via non-Faradaic mechanisms) is a result of the separation of charges (ionic and electronic) between the solution and electrode interface.[2,3]

Conducting polymers such as polyaniline, polypyrrole (Ppy), poly(3,4-ethylenedioxythiophene), poly(3-methylthiophene), and poly(1,5-diaminoanthraquinone) have been extensively investigated with regard to their potential as pseudocapacitor materials[4] due to the possibility of utilizing them in various industrial applications including sensors, batteries, anti-corrosion materials, membranes, transducers, optical storage media, and electrochemical devices.[5] Typically, they are inexpensive and relatively easy to prepare in comparison with metal oxides and carbon-based substances. Among the various conducting polymers, Ppy is extensively applied in high-performance pseudocapacitors[6] due to its good physio-chemical properties such as its high electrical conductivity, rapid redox switching, biocompatibility, and environmental stability, as well as a large capacitance and high storage capacity. Consequently, various polymerization methods have been utilized for the preparation of Ppy with different morphologies via either electrochemical or chemical routes at the micrometric or nanometric scales.[7] However, most conducting polymers (including Ppy) have poor charge/discharge cycling stability, believed to be due to the variation

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