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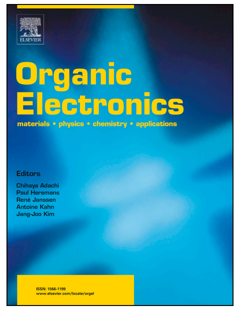

Conductivity, dielectric studies and structural properties of P(VA-co-PE) and its application in dye sensitized solar cell

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Conductivity, Dielectric Studies and Structural Properties of P(VA-co-PE) and Its Application in Dye Sensitized Solar Cell.

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Abstract

Poly(vinyl alcohol-co-ethylene), P(VA-co-PE) gel polymer electrolytes (GPEs) with sodium iodide (NaI) as a dopant salt was synthesized and investigated. Electrolytes containing different concentrations of NaI salt were studied using AC impedance spectroscopy, FTIR spectroscopy, and XRD spectroscopy. The results from dielectric studies reveal both the real part and imaginary part of complex permittivity decrease with increasing frequency. An opposite trend was observed when the temperatures of the samples were increased. Besides, the dispersion relation from the modulus studies confirmed that ionic conductivity is dominant in the GPE samples. Results from temperature studies reveal that all GPE samples conform the Arrhenius equation in the temperature range of 303 K to 373K. The sample with 40% of NaI exhibits the highest ionic conductivity of 2.266 mS cm^{-1} with the activation energy of 0.16808 eV. Furthermore, FTIR studies proved the complexation between P(VA-co-PE) and NaI. The crystallinity of the samples was shown to be increasing with the increasing concentration of NaI salt via XRD results. Finally, DSSCs were assembled using the polymer electrolyte and used for photovoltaic studies. The best performance of DSSC was obtained with the energy conversion efficiency of 3.32% using the GPE sample with 40% NaI.

Keywords: Dye sensitized solar cell, P(VA-co-PE), gel polymer electrolyte, dielectric behavior, FTIR, XRD

1. Introduction

Solar energy is believed to be the most critical source of energy following the depletion of non-renewable energy sources such as fossil fuels. One of the strong candidates to harvest the solar energy is dye-sensitized solar cell (DSSC). O'Regan and Gratzel had invented DSSC back in 1988 and since then, the development of DSSC had caught immense attention from researchers all over the world [1-2]. Development of DSSCs had made great promise due to many advantages including their low production cost and relatively high energy conversion efficiency compared to typical amorphous silicon solar cells [3-5]. However, long-term stability of DSSCs is still a huge challenge due to the fact that the electrolyte used were in the liquid form. One of the main challenges is that the liquid electrolyte is temperature-sensitive. Liquid electrolytes freeze at low temperature and expand dramatically over higher temperature making the range of operating temperature to be very small. Other problems such as high volatility, the danger of evaporation and degradation of the platinum counter electrode are some of the challenges to commercialize liquid-electrolytes based DSSCs [6-7]. Thus, work has been done to search for a substitution for the liquid electrolytes. This gives rise to