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Correction

Correction to: Ion transport, dielectric and electrochemical properties of sodium ion-conducting polymer nanocomposite: application in EDLC

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The original version of this article unfortunately has few errors in Abstract (line 4), Section 2.3 (line 3), and Section 4 Conclusion (lines 2, 6). In conclusion (line 2) word 'morphological' is now deleted. The below lines are eliminated from Abstract (line 4), Section 2.3 (line 3), and Section 4 Conclusion (lines 2, 6):

- Abstract
  'The morphology has been examined by Field emission scanning electron microscopy technique and confirms the composite formation.'
- Section 2.3 (first paragraph)
  'Morphological studies are examined using the field emission scanning electron microscopy (FESEM).'
- Section 4 (Conclusion)
  'and transition from crystalline to amorphous morphology is evidenced by FESEM.'

The corrected Abstract, Section 2.3 (first paragraph), and Section 4 Conclusion are as given below.

The original article can be found online at https://doi.org/10.1007/s10854-020-03639-6.

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Abstract

The present paper reports the investigation of structural, electrical, dielectric, and transport properties of the polyethylene oxide (PEO)-based polymer nanocomposite (PNC), with sodium hexafluorophosphate ($NaPF_6$) salt and barium titanate ($BaTiO_3$) as nanofillers. The PNC has been prepared via standard solution casting technique. The structural investigation has been investigated by X-ray diffraction and evidence the enhancement in amorphous content. The presence of polymer–ion and ion–ion interaction has been confirmed by the Fourier transform infrared spectra (FTIR) and evidences the PNC formation. The impedance spectroscopy has been performed to evaluate the ionic conductivity in the temperature range 40–100 °C. The increase of conductivity is obtained with the addition of nanofiller and temperature-dependent conductivity follows Arrhenius behavior. The PNC film having the highest conductivity exhibits low activation energy and indicates the fast ion migration. The ion transference number is close to unity and the voltage stability window is within the desirable limit. The complex permittivity and complex conductivity have been obtained and the plot has been fitted in the whole frequency window. The fitted plot is in perfect agreement with experimental data. The PNC having the highest conductivity has high dielectric strength and low relaxation time. It confirms the nanofiller role in enhancing ion migration. The ion transport parameters (n, μ, D) are also in correlation with impedance and dielectric analysis. The optimized PNC films have been used to prepare the Electric double-layer capacitors (EDLC) and it demonstrates the improved performance which may be attributed to the effective role played by nanofiller in boosting ion dynamics.

2.3 Characterization techniques

The microstructural information was obtained by X-ray diffraction (XRD) with CuK_α radiation (λ = 1.54 Å) in the Braggs angle (2θ) range from 10° to 70°. The investigation of interactions among various components of polymer nanocomposite is obtained using Fourier transform infrared (FTIR) spectroscopy (Model: Bruker Tensor 27, Model: NEXUS-870) recorded in absorbance mode in the wavenumber region 400–4000 cm^{-1}. Electrical properties like bulk resistance, ionic conductivity have been examined via Complex Impedance Spectroscopy (CIS 760; USA) for the frequency range 1 Hz–1 MHz and in the temperature range of 40–100 °C. An AC signal of 10 mV is applied to the PNC sample, sandwiched between stainless steel electrodes, in the cell configuration SS|PNC|SS.

4 Conclusion

In the present work, we have demonstrated the effect of $BaTiO_3$ nanofiller on the structural, electrical, thermal, dielectric, and ion transport properties of in PEO–$NaPF_6$ solid polymer electrolyte. The addition of nanoparticle suppresses the crystalline nature of polymer host (evidenced from XRD). The FTIR spectrum indicates the polymer–ion, ion, and polymer–ion–nanofiller interaction and confirms the polymer nanocomposite formation. The electrical conductivity is enhanced with nanofiller addition and temperature-dependent conductivity follows the Arrhenius nature. The optimum PNC film exhibits the highest conductivity and lowest activation energy. The almost unity value of the ion transference number confirms ionic conduction and a high electrochemical stability window ($\sim$ 5 V) is observed for the optimum system (PPS5) The high value of dielectric constant for the optimum system is due to more number of free charge carriers as evidenced from ion–ion interaction. The PNC films having the highest conductivity have low relaxation time as evidenced by the loss tangent and ac conductivity analysis. The temperature also enhances the ion dynamics as observed from an increase in dc conductivity, dielectric constant, and lowering of relaxation time. The ion transport parameters (n, μ, D) have been obtained by the FTIR, Complex Impedance spectroscopy, and Loss tangent method. All parameters show a perfect correlation with the conductivity and dielectric constant. The improved electrical and dielectric properties encouraged us to fabricate the EDLC cell using optimum PNC film as electrolyte and Carbon as an electrode. The prepared Electric double-layer capacitors (EDLC) show desirable performance. The specific capacitance of the EDLC cell is 134.16 F/g (10 mV/s). The specific energy density and specific power density for the EDLC cell are 5.99 Wh/kg, and 27.03 kW/kg, respectively (at 0.02 A/g). In conclusion, the prepared polymer nanocomposite has the potential to act as an electrolyte cum separator for supercapacitor applications.

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