Article

Structural, Impedance, and EDLC Characteristics of Proton Conducting Chitosan-Based Polymer Blend Electrolytes with High Electrochemical Stability

Shujahadeen B. Aziz 1,2,*, Rebar T. Abdulwahid 1,3, Muhamad H. Hamsan 4, Mohamad A. Brza 1,5, Ranjdar M. Abdullah 1, Mohd F. Z. Kadir 6 and Saifful K. Muzakir 7

1 Advanced Polymeric Materials Research Lab., Department of Physics, College of Science, University of Sulaimani, Qlyasan Street, Kurdistan Regional Government, Sulaimani 46001, Iraq; rebar.abdulwahid@univsul.edu.iq (R.T.A.); mohamad.brza@gmail.com (M.A.B.); ranjdar.abdullah@univsul.edu.iq (R.M.A.)
2 Komar Research Center (KRC), Komar University of Science and Technology, Kurdistan Regional Government, Sulaimani 46001, Iraq
3 Department of Physics, College of Education, University of Sulaimani, Old Campus, Kurdistan Regional Government, Sulaimani 46001, Iraq
4 Institute for Advanced Studies, University of Malaya, Kuala Lumpur 50603, Gombak, Malaysia; hafizhamsan93@gmail.com
5 Manufacturing and Materials Engineering Department, Faculty of Engineering, International Islamic University of Malaysia, Kuala Lumpur 50603, Gombak, Malaysia
6 Centre for Foundation Studies in Science, University of Malaya, Kuala Lumpur 50603, Gombak, Malaysia; mizkadir@um.edu.my
7 Material Technology Program, Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, Kuantan 43600, Pahang, Malaysia; saifful@ump.edu.my

* Correspondence: shujahadeenaziz@gmail.com; Tel.: +964-7511711435

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Abstract: In this report, a facile solution casting technique was used to fabricate polymer blend electrolytes of chitosan (CS):poly (ethylene oxide) (PEO):NH4SCN with high electrochemical stability (2.43V). Fourier transform infrared (FTIR) spectroscopy was used to investigate the polymer electrolyte formation. For the electrochemical property analysis, cyclic voltammetry (CV), linear sweep voltammetry (LSV), and electrochemical impedance spectroscopy (EIS) techniques were carried out. Referring to the FTIR spectra, a complex formation between the added salt and CS:PEO was deduced by considering the decreasing and shifting of FTIR bands intensity in terms of functional groups. The CS:PEO:NH4SCN electrolyte was found to be electrochemically stable as the applied voltage linearly swept up to 2.43V. The cyclic voltammogram has presented a wide potential window without showing any sign of redox peaks on the electrode surface. The proved mechanisms of charge storage in these fabricated systems were found to be double layer charging. The EIS analysis showed the existence of bulk resistance, wherein the semicircle diameter decreased with increasing salt concentration. The calculated maximum DC conductivity value was observed to be $2.11 \times 10^{-4}$ S/cm for CS:PEO incorporated with 40 wt% of NH4SCN salt. The charged species in CS:PEO:NH4SCN electrolytes were considered to be predominantly ionic in nature. This was verified from transference number analysis (TNM), in which ion and electron transference numbers were found to be $t_{\text{ion}} = 0.954$ and $t_{\text{el}} = 0.045$, respectively. The results obtained for both ion transference number and DC conductivity implied the possibility of fabricating electrolytes for electrochemical double layer capacitor (EDLC) device application. The specific capacitance of the fabricated EDLC was obtained from the area under the curve of the CV plot.