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Electrolyte Loaded Hexagonal Boron Nitride/Polyacrylonitrile Nanofibers for Lithium Ion Battery Application

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Abstract : In the present work, novel hBN/polyacrylonitrile composite nanofibers were produced via electrospinning approach and loaded with the electrolyte for rechargeable lithium-ion battery applications. The electrospun nanofibers comprising various hBN contents were characterized by using Fourier transform infrared spectroscopy (FT-IR), thermogravimetric analysis (TGA), X-ray diffraction (XRD) and scanning electron microscopy (SEM) techniques. The influence of hBN/PAN ratios onto the properties of the porous composite system, such as fiber diameter, porosity, and the liquid electrolyte uptake capability were systematically studied. Ionic conductivities and electrochemical characterizations were evaluated after loading electrospun hBN/PAN composite nanofiber with liquid electrolyte, i.e., 1 M lithium hexafluorophosphate (LiPF6) in ethylene carbonate (EC)/ethyl methyl carbonate (EMC) (1:1 vol). The electrolyte loaded nanofiber has a highest ionic conductivity of $10-3$ S cm^{-1} at room temperature. According to cyclic voltammetry (CV) results it exhibited a high electrochemical stability window up to 4.7 V versus Li+/Li. Li//10 wt% hBN/PAN//$LiCO_2$ cell was produced which delivered high discharge capacity of 144 $mAhg^{-1}$ and capacity retention of 92.4%. Considering high safety and low cost properties of the resulting hBN/PAN fiber electrolytes, these materials can be suggested as potential separator materials for lithium-ion batteries.

Keywords : hexagonal boron nitride, polyacrylonitrile, electrospinning, lithium ion battery
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