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Electrical properties and structure of nanocomposite electrolytes of ion-conducting polymer (PEO) doped with nematic liquid crystals (5CB) and single wall carbon nanotubes

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We conducted an in-depth investigation of the electrical and structural properties of flexible films (approximately 50 μm in thickness) composed of nematic nanocomposites, which were synthesized from the nematic liquid crystal pentylcyanobiphenyl (5CB), polyethylene oxide (PEO) polymer complexed with sodium metaperiodate ($NaIO_4$) as an ion donor, and single-walled carbon nanotubes (SWCNTs) incorporated as a conductive filler. The films' composi-tion was as follows: a 70:30 wt.% weight ratio of 5CB:PEO, $NaIO_4$ at 5 wt.%, and varying concentrations of SWCNTs from 0 to 0.25 wt.%. The SWCNTs exhibited an average diameter of 1.5 nm and an average length of 7 μm. The influence of SWCNT addition at different con-centrations on the properties of the PEO-5CB-$NaIO_4$-SWCNT films was systematically ana-lyzed. The films' microstructure was characterized using polarized optical microscopy, and their Na+ ion conductivity was determined by complex electrical impedance spectroscopy. Notably, the incorporation of SWCNTs led to a significant enhancement in the morphology and ionic conductivity of the PEO-5CB-$NaIO_4$-SWCNT films. This improvement positions the nanocomposites as promising candidates for dielectric and ion-conductive applications.

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