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Ion dynamics in halogen-free phosphonium bis(salicylato)borate ionic liquid electrolytes for lithium-ion batteries

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Abstract

© the Owner Societies 2017. This study was focused on the investigation of ion dynamics in halogen-free, hydrophobic, and hydrolytically stable phosphonium bis(salicylato)borate [P 4,4,4,8][BScB] ionic liquid electrolytes for lithium-ion batteries. The structure and purity of the synthesized ionic liquid and lithium bis(salicylato)borate Li[BScB] salt were characterized using 1 H, 13 C, 31 P, and 11 B NMR spectroscopy. The Li[BScB] salt was mixed with an ionic liquid at the concentrations ranging from 2.5 mol% to 20 mol%. The physicochemical properties of the resulting electrolytes were characteriz ed using thermal analysis (TGA and DSC), electrical impedance spectroscopy, and pulsed-field gradient (PFG) NMR and ATR-FTIR spectroscopy. The apparent transfer numbers of the individual ions were calculated from the diffusion coefficients of the cation and anion as determined via the PFG NMR spectroscopy. NMR and ATR-FTIR spectroscopic techniques revealed dynamic interactions between the lithium cation and bis(salicylato)borate anion in the electrolytes. The ion-ion interactions were found to increase with the increasing concentration of the Li[BScB] salt, which resulted in ionic clustering at the concentrations higher than 15 mol% of Li salt in the ionic liquid.

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