Journal of Power Sources
Volume 406, 1 December 2018, Pages 70-80

Stable cycling of $NaFePO_4$ cathodes in high salt concentration ionic liquid electrolytes

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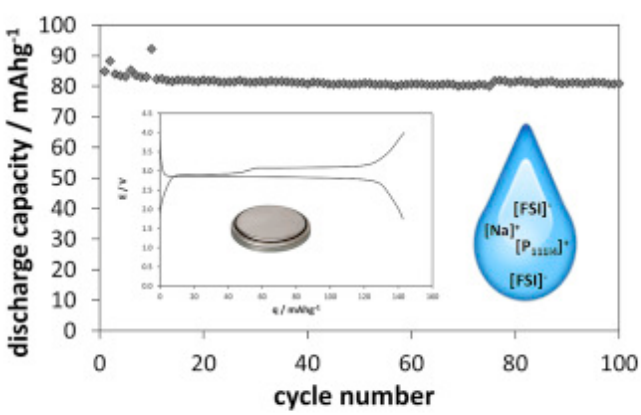
https://doi.org/10.1016/j.jpowsour.2018.09.102

Abstract

Highly concentrated solutions of sodium bis(fluorosulfonyl)imide (NaFSI) with a series of bis(fluorosulfonyl)imide-based ionic liquids incorporating either alkyl phosphonium or alkoxy ammonium cations (P_{111i4}FSI:NaFSI, $P_{1i4i4i4}$FSI:NaFSI), $N_{2(2O2O1)3}$FSI:NaFSI) are combined with $NaFePO_4$ cathodes to demonstrate excellent cycling performance with respect to potential range, rate capability, cycle life and elevated temperature stability. With a capacity of 85 $mAhg^{-1}$ and a capacity retention of 95% over 100 cycles (50 °C, C/2) P_{111i4}FSI:NaFSI matches or outperforms conventional organic solvent based electrolytes as well as other ionic liquid electrolytes in terms of capacity, elevated temperature performance and cycle stability. The electrolyte conductivity does not correlate with the capacity, suggesting that this is not the primary factor determining the cell performance. The solid electrolyte interphase determines the cycle stability with SEM and XPS techniques suggesting the presence of NaOH, Na_2S and NaF on the Na metal surface post cycling.

Graphical abstract



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