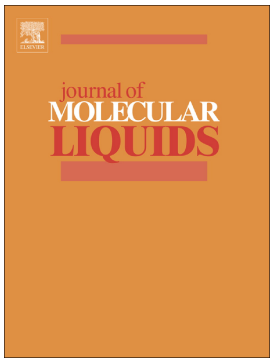

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Mixing ionic liquids and ethylene carbonate as safe electrolytes for lithium-ion batteries

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Abstract

With aim to design safety and high electrochemical-stability electrolytes, mixtures ionic liquids (ILs) – ethylene carbonate have been prepared and investigated for lithium-ion cell using $LiMn_2O_4$ (LMO) and $LiFePO_4$ (LFP) as cathode materials. The addition of 20 % vol. ethylene carbonate (EC) could decrease significantly the viscosity as well as improve ionic conductivity and cycling performance of the electrolyte at room temperature. In the electrolyte containing 20% vol. EC, lithium-ion diffusion coefficient is still lower than commercial one based on conventional solvents. However, the stable charge - discharge behavior with N,N-dimethyl-N-ethyl-N-propylammonium bis(trifluoromethanesulfonyl) imide (N_{1123}TFSI) based mixtures was achieved up to 120 $mAh.g^{-1}$ in the first cycle and remaining round 100 $mAh.g^{-1}$ within 20 cycles without any noticeable capacity loss, and a little bit lower with respect to 1-ethyl-3-methylimidazolium bis(trifluoromethanesulfonyl)imide (EMITFSI) and N,N-dimethyl-N-ethyl-N-butylammonium bis(trifluoromethanesulfonyl) imide (N_{1124}TFSI). The results also showed that the solvent addition up to 25% vol. maintained homogenous solution and good electrochemical stability of the electrolytes.

Keywords: Ionic liquids; ethylene carbonate; thermal properties, viscosity; conductivity; lithium ion diffusion.

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1. Introduction

Lithium battery is one of the most important electrochemical energy storage (EES) technologies with variety of application adapted to sectors which need high power reserves. The demand for EES is extremely large with diversified applications such as small portable devices, electric vehicles and large stationary application systems [1]. Therefore, the requirements for EES include not only higher specific power and energy but also the cycle life and security. However, there still exists some challenges relating to flammability, toxicity issues, chemical and electrochemical stability of lithium cell. In large scale application operating at elevated temperatures, the thermal and chemical instability of conventional electrolytes, usually based on organic carbonate, remains a main obstacle for its commercialization in market. Hence, developing a safe electrolyte is essential which has been