PHYSICOCHEMICAL PROPERTIES OF PYRAZOLIUM BASED IONIC LIQUID: 1-ETHYL-2-METHYLPYRAZOLIUM TETRAFLUOROBORATE

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The first low-temperature molten salts or ionic liquids were based on the haloaluminate ion. These ionic liquids exhibited very good physicochemical properties; therefore, they have been used as solvents for electrochemical investigations of numerous organic and inorganic compounds. However, these ionic liquids are water and oxygen sensitive. In the last ten years a number of imidazolium based ionic liquids with fluorine containing anions were synthesized and employed as solvents for electrochemical investigations of various systems. Recently, they have been utilized as solvents for chemical reactions as well. The above mentioned ionic liquids are neither water nor oxygen sensitive.

We have developed pyrazolium based low temperature molten salts(ionic liquids) which exhibit properties similar to those of the imidazolium salts; for example, high conductivity , high thermal stability, wide liquidus range, and good electrochemical stability. In addition, pyrazolium based melts are much more stable toward oxidation(chemical and electrochemical) and they are also compatible with lithium metal. This paper describes synthesis and physicochemical properties of 1-ethyl-2-methylpyrazolium tetrafluoroborate($EMPBF_4$) melt. The following properties are presented: melting point, thermal stability, compatibility with lithium metal, conductivity, and electrochemical stability obtained at different electrode materials.

Results obtained indicate that $EMPBF_4$ is stable to 300 ^oC. Further, it is compatible with lithium metal. No significant changes were observed either in lithium metal or in the melt in contact with lithium metal during 70 days at 150 ^oC. Conductivity was measured in the range of 50 ^oC to 150 ^oC. Electrochemical stability was determined by cyclic voltammetry. Cyclic voltammograms were acquired utilizing glassy carbon electrode, platinum electrode and tungsten electrode as working electrodes, platinum electrode as the counter electrode, and silver wire as quasi reference electrode or lithium electrode as reference electrode. Electrochemical window was ~ 4.4 V at glassy carbon electrode. Oxidation potential of ~5.5V and reduction potential of ~1.08 V vs. Li electrode were measured at the glassy carbon electrode.

Test cells $Li/LiMn_2O_4$ employing $EMPBF_4$ melt containing $LiAsF_6$ were constructed and tested. The cells showed high coulombic efficiency. $EMPBF_4$ melt appears to be a good candidate for electrolyte in safe lithium (lithium-ion) rechargeable cells.