Ionic liquid and Lithium salt immobilized MCM-41 based quasi solid-liquid electrolytes for lithium battery application

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In the present work a new class of Quasi solid-liquid electrolytes (QS-LEs) for lithium-ion batteries is prepared in "liquid-in-solid" form. The QS-LEs were synthesized using physical imbibition process of lithium salt-ionic liquid (LIL) solution into ordered mesoporous MCM-41. QS-LEs were characterized by N_2-sorption, DSC, SEM, TEM, TGA, and complex impedance spectroscopy techniques. N_2-sorption technique, DSC, SEM and TEM results suggest the enormous adsorption of LIL solution in the ordered mesopores channels and on the external surface of the MCM-41 particles. The ionic conductivity increases with increasing the amount of LIL solution and attains a value of ~6.37×10^{-4} S cm^{-1} at 30 °C and 1.60×10^{-3} S cm^{-1} at 70 °C for QS-LE containing high amount of LIL solution. Prepared QS-LEs are thermally stable upto ~360 °C and possess a wide electrochemical window ~5.23 V. A high total ionic transference number (~0.99) and cationic transference number (t_{Li}^+ ~0.35) for QS-LE containing high amount of LIL solution have also been obtained due to plenty adsorption of LIL solution in ordered mesoporous channels and on the external surface of MCM-41 particles. Furthermore, the Cells with $LiFePO_4$ cathode and QS-LE with 70 wt.% of LIL solution displayed good electrochemical properties (specific capacity ~153 mAh g^{-1} at C/10 rate; and good high rate capability ~100 mAh g^{-1} and 83 mAh g^{-1} at 1C and 2C rates respectively) and battery performance.