Electrochemical Characterization of Ionic Liquid based Gel Polymer Electrolyte for Rechargeable Li-ion Battery

Shishir Kumar Singh[1], Himani Gupta[1], Liton Balo[1], Shalu[2], Varun Kumar Singh[1], Alok Kumar Tripathi[1], Yogendra Lal Verma[2] and Rajendra Kumar Singh[1]*

[1]*Ionic Liquid and Solid State Ionics Laboratory, Department of Physics, Institute of Science, Banaras Hindu University, Varansi-221005, India*

[2]*Centre of Material Sciences, IIDS, University of Allahabad, Allahabad-211002, India*

E-mail: *shishirkumarsingh21@gmail.com*

Abstract: High molecular weight polymer poly(vinylidenefluoride-co-hexafluoropropylene) (PVdF-HFP), ionic liquid 1-ethyl-3-methylimidazolium bis(fluorosulfonyl)imide (EMIMFSI) and salt lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) based free-standing and conducting ionic liquid based gel polymer electrolytes (ILGPE) have been prepared by solution cast method. Thermal, electrical and electrochemical properties of 80 wt.% IL containing gel polymer electrolyte (GPE) are investigated by thermogravimetric, impedance spectroscopy, linear sweep voltammetry and cyclic voltammetry. The 80 wt.% IL containing GPE shows good thermal stability (~200 ^{o}C), ionic conductivity (6.42×10^{-4} S cm^{-1}), lithium ion conductivity ($\sigma_{Li+} = 1.40\times10^{-4}$ S cm^{-1} at 30 ^{o}C) and wide electrochemical stability window (~ 4.10 V versus Li/Li^{+} at 30 ^{o}C). Furthermore, surface of $LiFePO_4$ cathode material was modified by graphene oxide, with smooth and uniform coating layer, as confirmed by scanning electron microscopy and element content are also confirmed by energy dispersive X-ray spectrum. The graphene-oxide coated $LiFePO_4$ cathode shows improved electrochemical performance with a good charge-discharge capacity and cyclic stability upto 50th cycles at 1 C-rate, as compared with without coated $LiFePO_4$ coated. The pristine LFP cathode deliver the discharge capacity of 90.40 mAh g^{-1} with 95.30 % capacity retention at 1C-rate after 50 cycles, while GO@LFP cathodes delivers discharge capacity of 102.50 mAh g^{-1} with 98.0 % capacity retention at 1.0 C-rate after 50 cycles.

Figure:

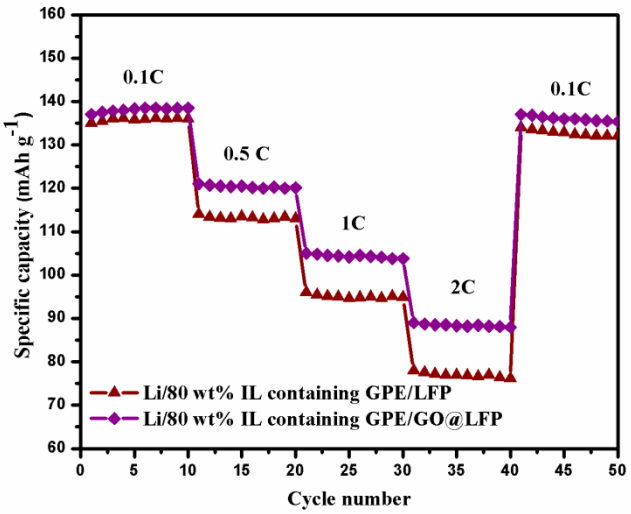

Figure. Rate performance of the pristine LFP and GO@LFP cathode with different current rate.