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Conductivity and dielectric studies of nanocomposite polymer blend electrolytes based on poly(ethylene oxide) using ultrasonic irradiation for lithium ion batteries

S. Jayanthi and B. Sundaresan
Ayya Nadar Janaki Ammal College, India

A series of nanocomposite polymer blend electrolytes (NCPBE's) based on poly(ethylene oxide) (PEO), poly(vinyl chloride) (PVC), lithium perchlorate($LiClO_4$) and nano sized TiO_2 (27.03nm) have been prepared by the solvent casting technique using conventional mechanical stirring and ultrasonic irradiation methods. AC impedance measurements have been carried out in the frequency range of 1Hz - 10 MHz. Ionic conductivity of NCPBE's increases with increasing concentration of TiO_2 and also increases against the ultrasonic irradiation time. An increase in ionic conductivity, of the order of 10^{-5} Scm^{-1} has been achieved for 4wt% of TiO_2 at an optimum ultrasonic irradiation time of 15 mins at room temperature than the sample without irradiation. The effect of ultrasonic irradiation on the dielectric properties and electric modulus have also been studied. In the low frequency region, the variation of dielectric constant with the frequency shows the presence of electrode interface polarization. Analysis of frequency dependence of dielectric and modulus spectra suggests that the ionic and polymer segmental motion are strongly coupled.

jaisuji87@gmail.com

Piezoelectric and dielectric properties of lead free KNN ceramics modified with Li and Sb $(K_{0.485}Na_{0.485}Li_{0.03})$ $(Nb_{0.96}Sb_{0.04})$ O_3

Roopam Gaur[1], K. Chandramani Singh[1] and Radhapiyari Laishram[2]
[1]University of Delhi, India
[2]Solid State Physics Laboratory, India

In order to produce lead free piezoceramics with optimum piezoelectric and dielectric properties, KNN modified with Li+ (as an A site dopant) and Sb^{5+} (as a B site dopant) $(K_{0.485}Na_{0.485}Li_{0.03})$ $(Nb_{0.96}Sb_{0.04})$ O_3 (referred as KNLNS in this paper) have been synthesized using solid state reaction method and conventional sintering technique. The ceramics were sintered in the range of 1050^0C-1090^0C for 2-3 hrs. Detailed study of dependence of dielectric and piezoelectric properties on sintering conditions was then carried out. The study suggests that the volatility of the highly hygroscopic KNN ceramics is not only sensitive to sintering temperatures but also to sintering durations. By merely reducing the sintering duration for a given sintering temperature we saw an increase in the density of the samples by 10-20%. And since density directly or indirectly affects almost all the associated properties, the dielectric and piezoelectric properties were also enhanced as we approached towards the most suitable sintering temperature and duration combination. Dielectric constant rises with the increase in density. Curie temperature also shifts to higher values as we approach optimum sintering condition. The detailed results are reported in this paper.

Keywords: Piezoelectric, Dielectric, Li, Sb, KNN, Conventional sintering.

gaur.roopam@gmail.com