Single lithium ion conducting polymer electrolytes for LIB based on sp^3 boron and Poly(ethylene glycol) doped with Si, Ti, and Zr

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Safety issues during Lithium Ion Batteries operation have been long recognized as one of the main drawbacks of this type of energy storage systems. Most of the risks are related to the use of conventional liquid electrolytes which present potential hazards of leakage, combustion and battery explosion. The replacement of liquid electrolytes by polymer electrolytes can help to enhance the safety of the system, among the different possibilities, Poly(ethylene glycol) (PEG) has been broadly studied as a prospective polymer electrolyte, due to presence of repeating highly polar ether units that allow Li salt dissociation. Several strategies have been developed to improve their mechanical properties, such as organically modified ceramics (ORMOCER). However, the improvement in the mechanical properties due to the ceramic-polymer interactions, is accompanied by a decrease in the ionic conductivity [1, 2]; therefore, it is important to determine the ceramic type and concentration that allows the improvement of both, the mechanical properties and intrinsic conductivity. In addition, chelatoborates have been widely studied [3], since the boron atoms have a *p*-orbital which can strongly interact with the basic anion of lithium salts, thereby causing the increase of t_{Li^+}, in both liquid and polymer electrolytes [4].
In this work, we report the electrochemical characterization of single lithium ion conducting polymer electrolyte (SLICPE) based on sp^3 boron atoms, doped with Si, Ti and Zr. The polymer electrolyte is synthesized by polycondensation in a single step. The utilized precursors are lithium tetra methoxy borate $LiB(OCH_3)_4$, poly (ethylene glycol) PEG400 and the respective Alkoxides ($Si(OCH_2CH_3)_4$, $Zr(OCH_2CH_3)_4$, $Ti[OCH(CH_3)_2]_4$) as Si, Ti and Zr sources, respectively. The effect the doping entities and the content of these in the SLICPE intrinsic conductivity is studied as a function of temperature [5].
In general, the analysis of the results indicates that the ionic conductivity (10^{-5} Scm^{-1} @ 30°C) of the polymers make them good candidates to replace liquid electrolytes in lithium Ion batteries. In addition, it is shown that the increase in the concentration of dopants in the SLICPE up to 10 wt. %, increases the conductivity of the lithium ion, beyond this point the functionality of the polymer as conducting electrolyte is lost. Moreover, it is observed that the Lithium conduction mechanism is not affected by the modification of the polymers with the doping process.

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