Gel polymer membrane based on PEO-PVdF blend as an alternative for lithium metal battery electrolyte.

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In the framework of the development of new technologies (laptop computers, mobile phones and electric vehicles) an increasing effort is devoted to the improvement of battery performances. Among them rechargeable lithium metal batteries are very promising systems. One of the key points of these technologies is the operating temperature. Therefore gelled polymer membranes appear to be more efficient [**1**] as electrolyte in the room temperature domain than dry solid electrolyte such as poly(ethylene oxide) (PEO). In this work, we present the study of a PEO-PVdF-EC-PC based gel doped by a lithium salt, LiTFSI.

Electrochemical impedance spectroscopy (EIS) investigations were performed on symmetric Li/gel/Li cells. The Nyquist plots show two major contributions: i- the high frequency loop due to the bulk of the gel and ii- the lower frequency arc is due to the interface between the gel and the lithium foil. The last contribution may be attributed to the lithium passivation in contact with the gel and also to the electronic transfer at this interface.

The variations of those two contributions as a function of time (aging) at 20°C and 70°C, as well as the evolution versus temperature in the range [70°C, -40°C] are given. The gel is thermodynamically stable until 70°C which a very reversible conductivity behavior in the explored temperature range and it presents a conductivity value around $10^{-3}Scm^{-1}$ at 20°C. The lithium passivation gives an important increase in the resistance (LF) after aging. This surface layer presents different characteristics compare to the solid polymer electrolyte PEO-LiTFSI/Li interface, which is used as reference [**2**]. The galvanostatic polarization of the cells shows a decrease in the cell potential by a factor 5 (see figure 1a). The EIS spectra obtain during the cell polarization indicate that the interface contribution decrease by a factor 7 (see figure 1b and 1a), suggesting the breaking of the passive layer under dynamic conditions. Furthermore, from this experiment, we are able to deduce the low frequency impedance, i.e. the diffusion resistance. Finally, the feasibility of reaching 350 cycles at room temperature with a rechargeable Li battery having PEO-PVdF-EC-PC based gel electrolyte is quite encouraging for applications.

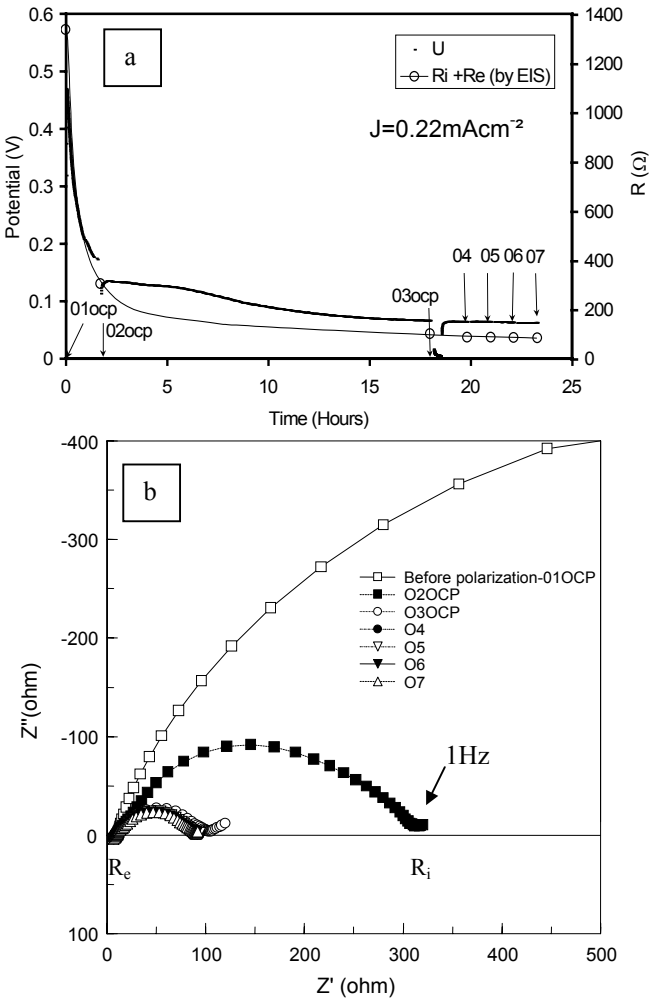

Figure 1: Superposition of the galvanostatic polarization and the polarization due to the deduced impedance (EIS) at 1 Hz (a), and (b) the Nyquist plot of the impedance made on the points given in figure a.

[1] P. P. Prosini, S. Passerini, Solid State Ionics, 146, 2002, 65-72
[2] R. Bouchet, S. Lascaud, M. Rosso, accepted in J. Electrochem. Soc.