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Solid electrolyte interface formation on Lithium metal anode in gel polymer electrolytes

Main reason preventing successful deployment of rechargeable Lithium metal batteries is connected with inhomogeneous and electrochemically unstable Solid electrolyte interface (SEI) formation on lithium metal surface[1-3]. At the present work the SEI stabilization formed on Li-metal anode in contact with Polyacrylonitrile (PAN) –and poly(ethylene oxide) (PEO) –based polymer/gel polymer electrolytes containing various salts (Bis(trifluoromethane)sulfonimide lithium (LiTFSI) and Lithium perchlorate (LiClO4)) and plastisizers (DMF, EC and PC) has been investigated.

The comparison of the polymer electrolyte ending groups PAN (-CN) and PEO (-O-) influence on lithium interface stability has been carried out by means of different independent techniques: XPS, Chronopotenciometry and Impedance spectroscopy techniques.

The method of X-ray Photoelectron Spectroscopies (XPS) was used to obtain information on the chemical composition, bonding and homogeneity of gel-polymer/lithium metal interface. For the accurate estimation of chemical SEI film stability in contact with the lithium metal anode few lithium monolayers were deposited on the surface of specially fabricated PAN –and PEO –based polymer membranes. A Quartz Crystal Microbalance (QCM) Technique was used for the in situ control of the mass change during Li deposition process. As the result the evolution of SEI layer thickness was detected.

Impedance spectroscopy technique was used to evaluate the resistance of the formed SEI films during time evolution or under polarization. Lithium cation transference numbers t(Li+) for both types of electrolytes were defined to evaluate the contribution of the cationic species to the overall conductivity of the formed polymer films by means of DC polarization and AC impedance methods. Complete analysis of the obtained dataset in PEO –and PAN –based polymer electrolyte shows that combination of mentioned techniques allows not only to determine transport properties of lithium/gel polymer interface films covering the electrode, but also provides with an assessment of newly formed surface layers composition.

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