

A QUASI-SOLID STATE THIN FILM LITHIUM μ -BATTERIE USING A POLYMER ELECTROLYTE

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Herein, we report, for the first time, the preparation and the characterization of an interpenetrated polymer network electrolyte (IPNE) in a thin film lithium μ -batteries (μ LIBs). The IPNE was prepared by thermal free radical polymerization of methacrylate oligomers in the presence of 1-butyl-1-methylpyrrolidinium bis(fluorosulfonyl)imide (P14FSI) and lithium bis(trifluoromethylsulfonyl)imide (LiTFSI) ¹

The study was conducted by varying the composition of the cross-linked electrolyte (e.g. the ratio of RTIL/oligomers and LiTFSI/RTIL, the rate of cross-linking) in order to achieve an optimized composition allowing a compromise between mechanical properties, liquid confinement inside the polymer network and electrochemical performances of the quasi-solid IPNE. Lithium transference number and ionic conductivity were determined as function of the electrolyte composition and Nuclear Magnetic Resonance (NMR) spectroscopy with Pulsed Field Gradients (PFG) was used in order to measure the self-diffusion coefficients in the electrolyte. Furthermore, a thin film Lithium μ -battery was successfully constructed and cycled. The μ -battery was consisting of a stack of a thin layers of active materials (lithium anode, LCO cathode and IPNE) where the IPNE plays a role of both electrolyte and separator. The thin lithium anode (5 μ m thick) was directly grown on the IPNE (5 to 10 μ m thick films) by metal thermal evaporation technique leading to a compact and stable lithium/polymer electrolyte assembly which was further added to a thin LCO cathode to get the full μ -battery. After assembling, the μ -battery showed an open circuit voltage around 3 V and was cycled at different speed showing excellent capacity retention even at high speed (1C) and very promising stability (over 100 cycles).

References:

[1] F. Ghamouss, V. Chaudoy, E. Luais, F. Pierre, F. Tran-Van, « Microbatterie au lithium et procédé de fabrication », PCT/Fr2017/053086. Patent.