

THIOL-ENE POLYMERIZATION TOWARDS EASILY UP-SCALABLE GEL POLYMER ELECTROLYTE

Mattia Longo¹, Matteo Gandolfo¹, Carlotta Francia¹, Silvia Bodoardo¹, Julia Amici¹

¹ Electrochemistry group, Department of Applied Science and Technology, Politecnico di Torino, C.so D.ca degli Abruzzi 24, 10128 Torino, Italy

The continuous increase in energy consumption worldwide has catalysed the attention of both academy and industry on the production of safer and most efficient energy storage systems. The commonly employed Li-ion technology presents an intrinsic low safety due to the presence of liquid organic solvents which are prone to leakage and flammable, thus increasing the hazard risk upon battery short circuit. A simple solution to leakage is the employment of solid or semi-solid polymer electrolytes. Gel polymer electrolytes (GPEs) present the best compromise between mechanical and electrochemical properties, as well as an improvement of the cell safety [1]. The UV mediated radical polymerization is a common GPE fabrication strategy due to its speed and low cost. However, the polymerization can only start in the presence of an initiator, and it is hindered by oxygen, thus impeding the industrial scale up of the GPEs production. In this work, an UV mediated thiol-ene photopolymerization, employing polyethylene glycol diacrylate (PEGDA) and two different thiols (trimethylolpropane tris(3-mercaptopropionate) - T3 and pentaerythritol tetrakis(3-mercaptopropionate) - T4) as oligomer and crosslinkers, respectively, was carried out in a liquid electrolyte solution (1 M LiTFSI in EC/DEC) in order to obtain a self-standing GPE. The thiol-ene polymerization mechanism enable an easily up-scalable, fast, cheap and environmentally friendly GPE production, eliminating the need for a photoinitiator and an inert atmosphere [2]. A comparative study between the properties of membranes cured in an inert Ar atmosphere, as well as GPEs produced in a dry atmosphere, was performed. All the produced GPEs present an excellent room temperature ionic conductivity above 1 mS cm⁻², as well as a wide electrochemical stability window up to 4 V, demonstrating comparable properties when produced in presence or absence of oxygen and humidity. The full cells were tested to evaluate the rate capability of the GPEs comparing between membranes produced as self-standing and subsequently sandwiched between anode and cathode (referred to ex-situ), and GPEs directly cured on the cathode surface (referred to as in-situ).

References

1. Baroncini, E. et al., "Incorporating allylated lignin-derivatives in thiol-ene gel-polymer electrolytes," *International Journal of Biological Macromolecules*, 2018, 113, 1041–1051.
2. Hoyle, C.E. et al., "Thiol-ene Click Chemistry," *Angew. Chem. Int. Ed.* 2010, 49, 1540 – 1573.

