

# FLUORINATED ELECTROLYTES FOR PEM FUEL CELLS AND LITHIUM ION BATTERIES

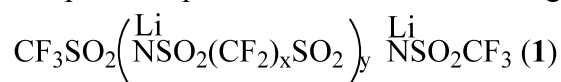
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This lecture will focus on some recent research seeking to find new single ion conductors for lithium ion batteries and improved proton exchange membranes for fuel cells.

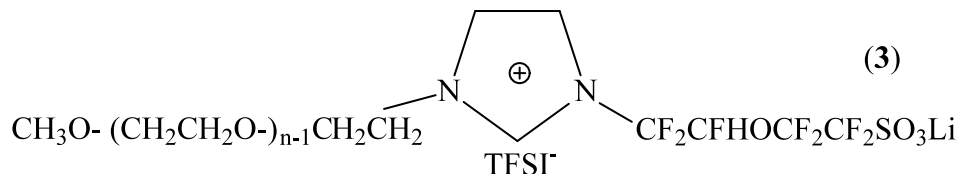
For high power density secondary lithium ion batteries, there are many challenges, especially the electrolyte. Polymer electrolytes based on PEO and other variations have high potential but the Li conductivities are too low. Initially we hoped to improve conductivities using oligomeric bis((perfluoroalkyl)sulfonyl)imides (**1**) in PEO matrices as an improved variant to LiTFSI in PEO [1]. Our hope for improved conductivities and high  $t_{Li^+}$  were not realized.



Next we examined some novel ionic melts (**2**). These materials showed good conductivity and  $t_{Li^+}$  values near 1.0, but the high viscosity limited mass transport [2].



Numerous variations of the ionic melts were explored including imidazole derivatives (**3**). [3]



Currently we are evaluating the novel homopolymer of (**4**). Depending on polymerization conditions, (**4**) gives a gel-polymer which can be swollen in organic solvents and used as a Li battery electrolyte.

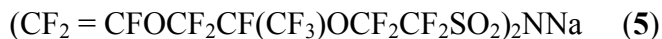


Hydrogen/oxygen fuel cells using proton exchange membranes (PEMs) as the electrolyte and separator are promising technology for mobile power and other applications. Many hurdles remain to be solved for their wide utilization, including a PEM with sufficient conductivity at lower RH and temperatures greater than 110°C. We have focused our efforts on a variant (**5**) of PFSA polymers such as DuPont's Nafion®



These copolymers have shown excellent performance in single-cell MEA testing when compared to PFSA's. [4] However these materials tend to have the same shortcomings as PFSA polymers at

lower RH. We have investigated several approaches to alter the microstructure of (4) so that the mass transport in the polymer is improved at lower RH. One approach has been the blending of the aqueous emulsions from the polymer preparation using high and low equivalent weight polymer batches. Another approach has been the use of a crosslinking monomer in a terpolymerization. The new crosslinking monomer (5) shows promise.



These and other approaches will be discussed as time allows.

#### References

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