Optimizing formulation of blend polymer electrolytes:

We had performed preliminary studies for the optimization of the blend electrolyte formulation. The weight percentage of the P(VDF-TrFE) matrix was used similarly to reported values, i.e. 6-10% for polymer with molecular weight above $5x10^5$. In case of the P(VDF-TrFE) used here with M_w~534000, a fixed weightage of 6% was used. We then studied the effects of varied ratio between Li salt and PEO plasticizer. Solid polymer electrolyte with ratio of 1 Li atom to 6 ether oxygen atoms in PEO molecular chain has been reported to have the highest conductivity value in the crystalline phase [1]. Based on this, we formulated the blend electrolyte using PEO 1000 with variation of Li:O ratio including 1:3, 1:6, and 1:12. The ionic conductivity was observed to be similar in the dry ambient (RH<40%). Towards to high humidity level (50-90%), conductivity values increased for electrolyte with higher Li salt concentration (1:3 and 1:6 ratio). Ionic conductivity data are shown in Figure 1. However, the electrolyte with highest Li salt concentration (1:3) was not physically stable in the range of ~0%RH (glove box) to ~55%RH (normal ambient). Cracks were seen in the electrolyte film once the sample was subjected to these humidity levels. This was due to the crystallization of the excessive Li salt in the dry environment, which formed phase separation with the polymer matrix. As a result, the formulation of 1Li : 6O was chosen. To examine the effect of plasticizing by various molecular weights of PEO, we fixed the weightage of Li salt and PEO at 4% and 10%. This corresponds to 1Li : 6O for PEO 1000 but the ratio is lower for PEO 8000 and 20000.

1. *Z. Gadjourova, Y. G. Andreev, D. P. Tunstall, and P. G. Bruce, Nature, 2001, 412, 520*

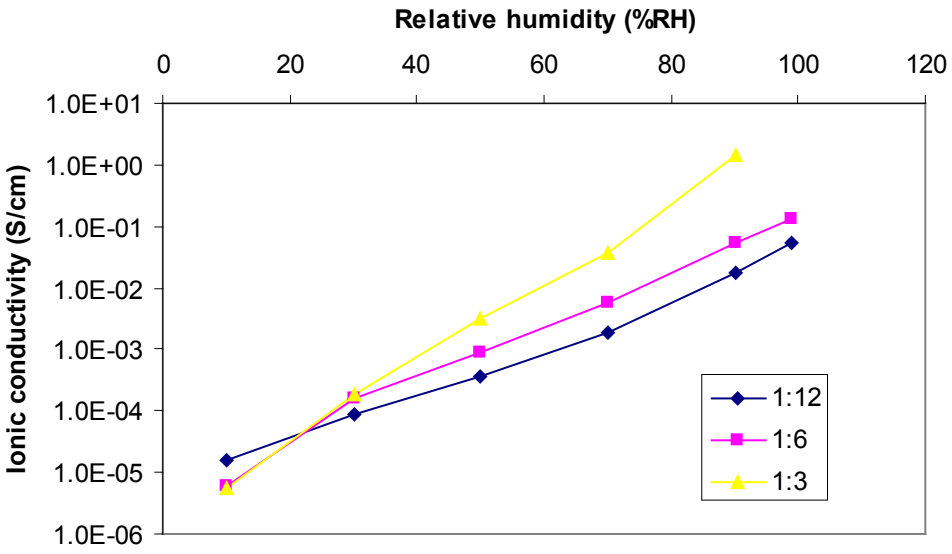

Figure 1 – Ionic conductivity of blend electrolyte with various ratios of Li and O atoms at different humidity levels.