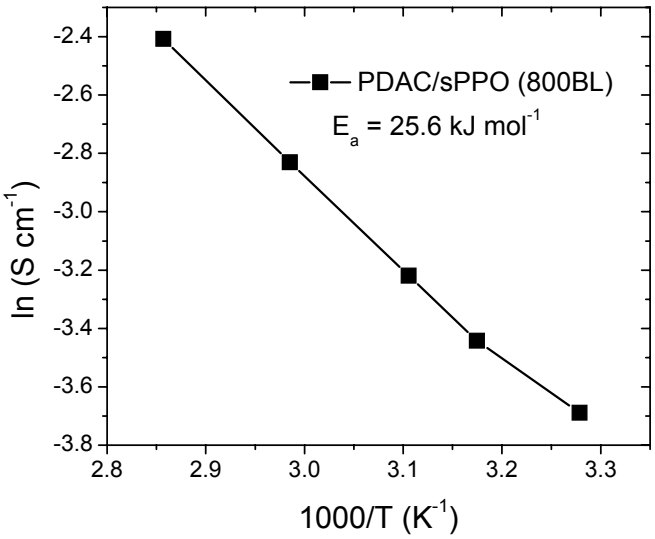

Figure S1. Temperature dependence of ionic conductivity of a PDAC/sPPO film immersed in water. The film assembly occurred in the presence of 0.5M NaCl followed by membrane protonation in 0.1M HCl solution and thorough rinsing in deionized water.

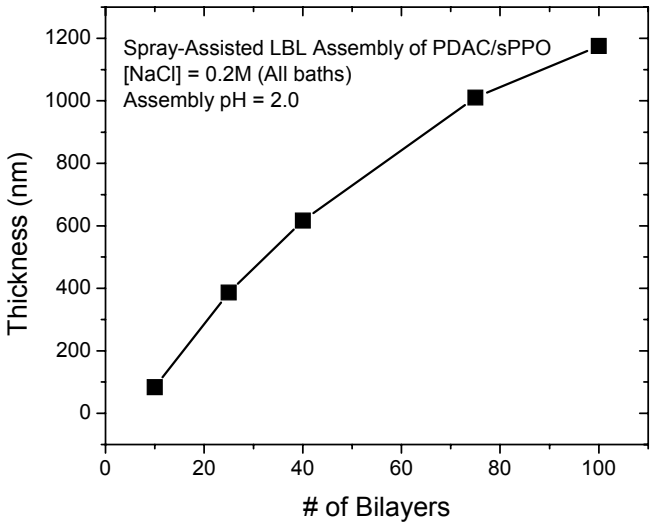

Figure S2. The growth curve for spray-assisted LBL assembly of PDAC/sPPO films on glass

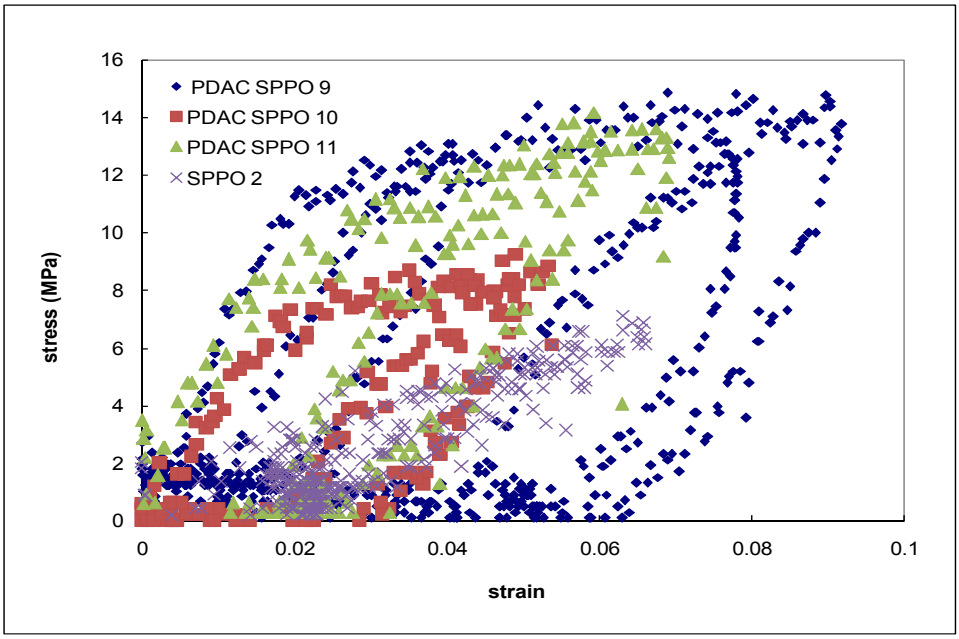

Figure S3. Stress-strain curves for sPPO and PDAC/sPPO films. See the Table S1 below for the assembly conditions.

Description	Carbon (%)	Hydrogen (%)	Nitrogen (%)
pH=2, No NaCl	53.9	7.08	4.42
pH=2, 0.2 M NaCl all baths	50.6	7.27	4.41
pH=2, 0.5 M NaCl all baths	53.1	7.31	4.46
pH=2, 0.5 M NaCl in sPPO only	50.8	7.40	4.29

Figure S4. Elemental analysis for PDAC/sPPO films assembled with various salt concentrations in the assembly baths.

Table S1. Mechanical data for sPPO and PDAC/sPPO films at ambient conditions.

Name	Description	Thickness (microm)	Elastic Modulus (MPa)	Yield Stress (MPa)	Break Strain(%)
PDAC SPPO 9	250bl, pH=2, 0.5MNaCl	8	523	10.9	9
PDAC SPPO 10	250bl, pH=2, 0.2MNaCl	8	412	7.4	5
PDAC SPPO 11	400bl, pH=2, 0MNaCl	5	474	8.7	7
SPPO 2	250bl, pH=2, 0.5MNaCl	7	120	NA	6

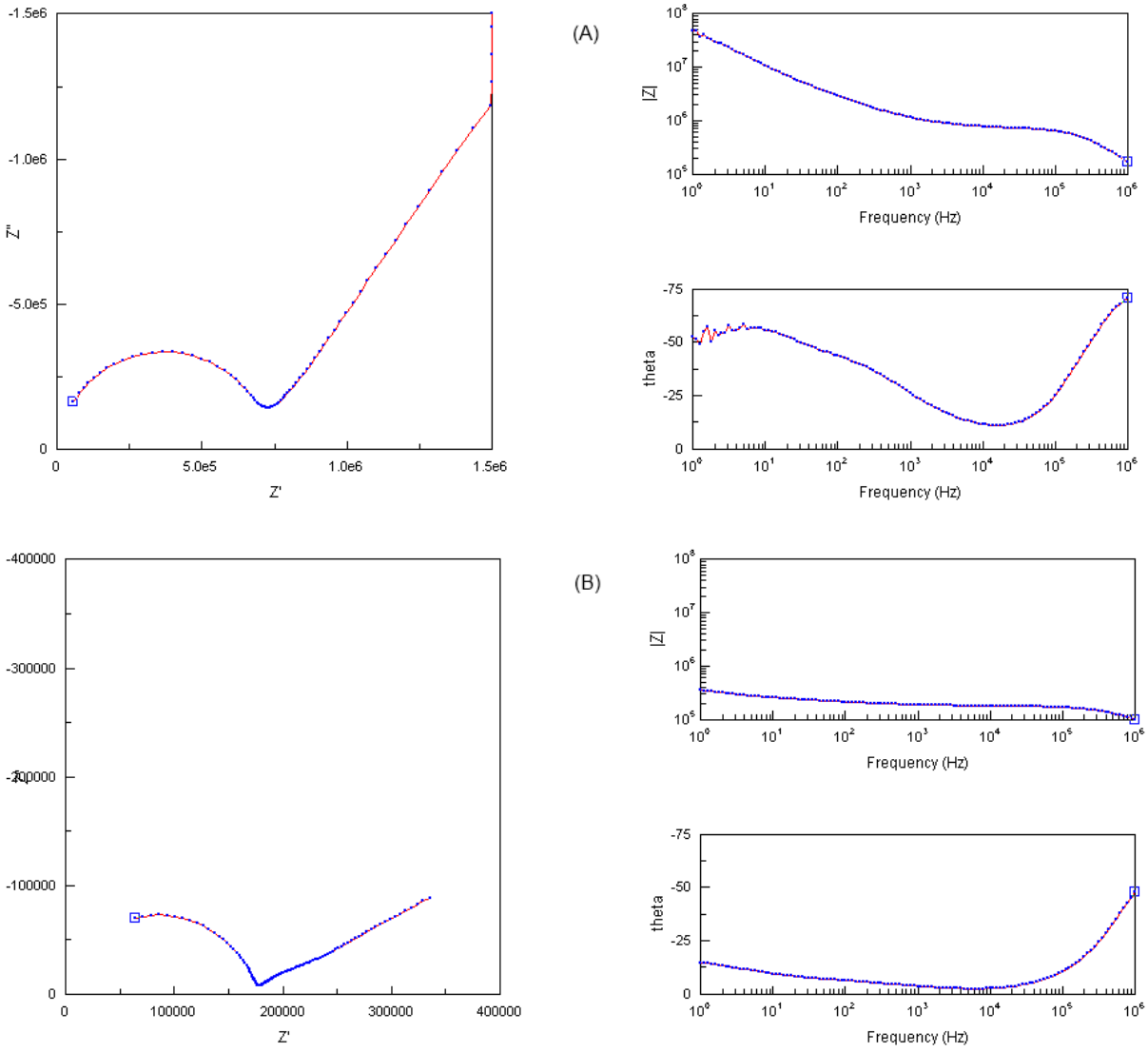

Figure S5. Representative AC impedance plots showing NyQuist (complex) and Bode plots at frequencies 1Mhz down to 1Hz for a) 125 Bilayers PDAC/sPPO and b) 250 Bilayers PDAC/sPPO. Both films were kept and equilibrated at 80% RH prior to measurement.