Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

In-situ measurement of swelling induced stress of thin Nafion films during hydration cycles BRADLEY FRIEBERG, KIRT PAGE, GERY STAFFORD, CHRISTOPHER SOLES, Natl Inst of Stds & Tech (NIST) — Perfluorinated ionomers, in particular Nafion, are a critical component in hydrogen fuel cells, as the binder within the membrane electrode assembly in which it can be confined to thicknesses on the order of ten nanometers. During normal operation of a hydrogen fuel cell the ionomer will progressively swell and de-swell in response to the changes in hydration, resulting in a mechanical fatigue and ultimately failure of the fuel cell with time. In this study we have developed and implemented a cantilever bending technique in order to investigate the swelling induced stresses in Nafion thin films. By monitoring the deflection of a cantilever beam coated with a polymer film as it is exposed to varying humidity environments, the swelling induced stress-thickness of the polymer film can be measured. By combining the stress-thickness results with a measurement of the film thickness as a function of humidity, the swelling stress can be determined. Using this technique we have measured the shear modulus and estimated the Young's modulus of thin Nafion films as a function of film thickness (ranging from 30 nm to 200 nm), processing conditions and humidity.

Bradley Frieberg
Natl Inst of Stds & Tech (NIST)

Date submitted: 14 Nov 2014 Electronic form version 1.4