Effect of Relative Humidity and Temperature on the Mechanical Properties of PFSA Nafion™-cation-exchanged membranes for Electrochemical Applications

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Perfluorosulfonic acid (PFSA) polymer membranes, also known as PEM (proton-exchange membranes), such as Nafion™ are widely used as electrolyte thin films in electrochemical hydrogen energy systems such as fuel cells, electrolyzers and electrochemical hydrogen compressors. In the present work the effect of temperature and relative humidity on the elastic moduli of various PEMs were investigated through uniaxial and biaxial tensile testing. Results of the two techniques were analysed and compared to one another to determine the validity of bulge testing in the investigation of the mechanical properties of PEMs. The bulge test technique was applied to assess the effect of elevated temperatures, humidity levels and cation contamination on the rupture pressure of the membranes. The effects of cation exchange and water absorption on the mechanical strength of PEMs are discussed in terms of cation water interactions within the molecular structure of PFSA polymers.

Keywords: Nafion™, proton-exchange membrane, PFSA, membrane rupture test, biaxial strength, elastic modulus, cation contamination, relative humidity and temperature.

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