GENERATION 1 HIGH-PRESSURE MEMBRANE RUPTURE SYSTEM

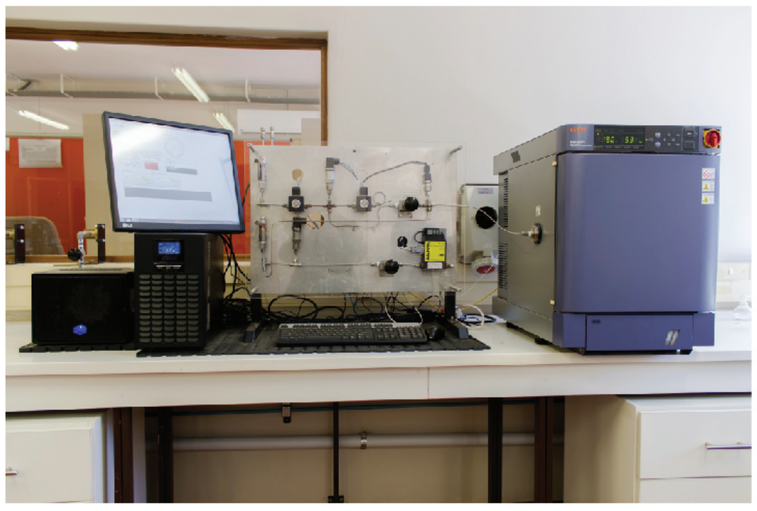
Overview

HySA ***Infrastructure*** has developed a high-pressure membrane rupture system for the characterization of proton exchange membranes at operational conditions found within electrochemical hydrogen energy systems such as electrochemical hydrogen compressors, hydrogen fuel cells and electrolysers.

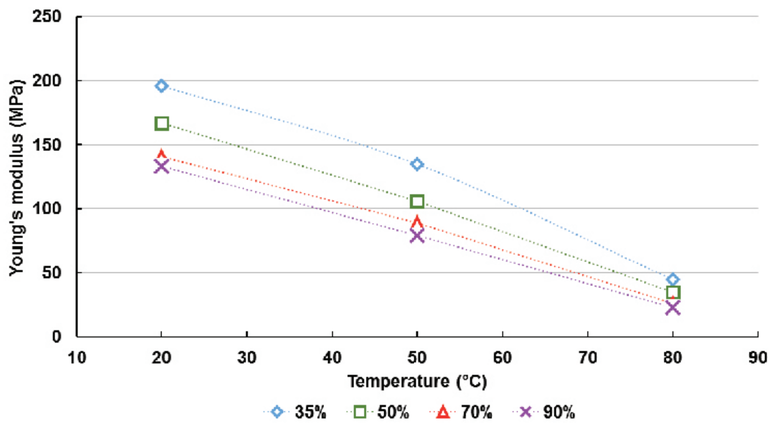
Within electrochemical membrane hydrogen energy systems, proton exchange membranes are subject to degradation, therefore a fundamental understanding of the mechanical and viscoelastic properties of the materials under operational conditions is required to ensure safe operation. The degradation of the membrane is caused by electrochemical and mechanical stresses such as large pressure differentials, contamination, environmental variation and oxygen activation, which leads to membrane thinning, tensile strength loss and pinhole formation.

The purpose of this research is to study the effect of temperature, relative humidity and cation exchange on the Young's modulus and burst strength of the proton exchange membranes.

Gen-1 high-pressure membrane rupture system



High Pressure Cell



Elastic modulus of Nafion 115 at 200˚C, 500˚C and 800˚C and RH levels of 35% to 90%

High-pressure rupture system

The system is used to investigate the biaxial strength of the PEM materials to better understand the influence of stresses caused by of temperature and RH variation and contamination on the degradation and mechanical strength of the membrane material.

High-pressure cell

The system has the capability of determining viscoelastic mechanical properties of membrane materials such as burst strength and elastic modulus at temperatures of -25˚C to 160˚C at relative humidity levels of 10% to 100%.

Conclusion

The EW of partially hydrolysed membranes were shown to decrease as a result of hydrolysis. The structure of the membrane becomes more stable, resulting in greater rupture pressure at lower EW. It was also shown that reinforced membranes show a significant improvement of the mechanical strength of the membrane material compared to non-reinforced membranes, and that some methods of reinforcement are less effective than others.