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On the Experimental Investigation of the Clamping Pressure Effects on the Proton Exchange Membrane Water Electrolyser Cell Performance

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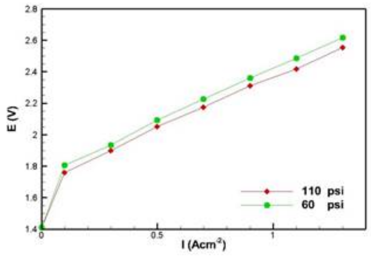
Abstract Text:

The intermittent renewable and power energy sources can be effectively utilized using hydrogen energy storage technology. Hydrogen has the highest energy capacity per unit weight of any known other fuel. Also it is considered as a promising energy carrier and a future replacement for fossil fuel energy sources. The proton exchange membrane water electrolyser (PEMWE) is the most candidate technology to produce hydrogen from renewable energy sources. PEMWE cell splits water into hydrogen and oxygen when an electric current is passed through it. Electrical current forces the positively charged ions to migrate to negatively charged cathode, where hydrogen is reduced. Meanwhile, oxygen is produced at the anode side electrode and escape as a gas with the circulating water.

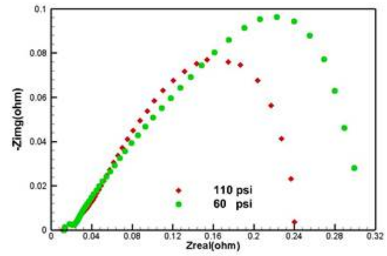
In the recent few years, PEMWE's R&D has inched towards; operating conditions; such as increased operating temperature and cathode-anode high differential pressure operation, flow field design, stack development, and modeling. In this work the effect of clamping pressure on the PEMWE cell performance is studied. A 50 cm^2 active area PEMWE cell with double serpentine flow field channels for the anode and cathode side is used. The standard electrochemical technique to characterize the performance of electrochemical cells is the polarization curve. Thus, the IV curves are measured at different clamping pressures. Also, the electrochemical impedance spectroscopy (EIS) is used as a non-invasive technique to characterize the electrochemical processes at different clamping pressures. All these measurements are conducted at constant cell temperature (70°C) and atmospheric pressure. Furthermore, to ensure a high confidence level in the obtained data, experiments are repeated few times.

Early results for polarization curve predict that the PEMWE cell performance increases with increasing the clamping pressure at fixed temperature and current density. This can be elucidated by the EIS measurements which predict an increment in ohmic and activation

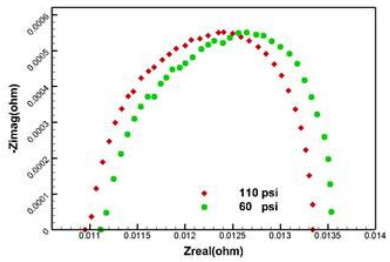
resistance at lower clamping pressure values for the same temperature and current density.



IV curves at different clamping pressures and a nominal cell temperature of 70°C.



EIS measurements at different clamping pressure for the cell current density of 0.1 Acm^{-2} and a nominal cell temperature of 70°C.



EIS measurements at different clamping pressure for the cell current density of 1.3 Acm^{-2} and a nominal cell temperature of 70°C.

Ohmic and activation resistance at different clamping pressure and current densities

	R_{ohm}(Ω)		R_{act}(Ω)	
I(A/cm^2)/CP (psi)	**110**	**60**	**110**	**60**
0.1	0.011253	0.01327	0,228941	0,288095
1.3	0,010951	0,011113	0,002391	0,002425

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