

A review of PEM URFCs and hydrogen compressors

P. Millet

Institut de Chimie Moléculaire et des Matériaux, UMR CNRS n° 8182, Université Paris-Sud, 15 rue Georges Clémenceau, 91405 Orsay cedex France

Polymer Electrolyte Membrane (PEM) technology is usually used for fuel cell [1] and water electrolysis [2] applications. The same concept of PEM cell can also be used for other applications such as Unitized Regenerative Fuel Cells (URFCs) or hydrogen purification/compression cells. A URFC [3] is a reversible electrolyzer-H₂/O₂ fuel cell system. Such electrochemical device can be alternatively operated in water electrolysis or H₂/O₂ fuel cell modes. Whereas PEM water electrolysis and PEM H₂/O₂ fuel cell technologies are individually well-established, optimized and efficient technologies, it is still a challenging task to develop efficient URFCs, that can sustain repeated operation cycles with the same level of electrochemical performances than their individual counterparts. The PEM cell can also be used for hydrogen purification (selective electrochemical extraction of hydrogen from various gas mixtures) and for hydrogen electrochemical compression (a DC power source is used for hydrogen compression) [4,5]. Alternatively, the hydrogen purification and compression devices can be merged into a single device that achieves both functions and delivers purified and compressed hydrogen.

The purpose of this communication is to provide a brief review of the state-of-the-art in these fields, including recent developments. The discussion will cover main aspects such as general principles (thermodynamics and kinetics), material science (electrocatalysis, polymer electrolytes), cell design (cell components and cell geometry), electrochemical engineering (cell stacking), electrochemical performance and efficiency, SWOT analysis, and economic aspects.

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References

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