HIGH TEMPERATURE PEM FUEL CELL STACKs

C. Neofytidis, F. Paloukis, N. Athanasopoulos, M.K. Daletou*, S.G. Neophytides**

Foundation of Research and Technology, Hellas - Institute of Chemical Engineering Sciences, FORTH/ICEHT, Stadiou Str, Platani Rion, P.O. Box 1414, Patras GR-26504, Greece

** email: riadal@iceht.forth.gr*

*** email: neoph@iceht.forth.gr*

ABSTRACT

High power applications are expected to benefit greatly from high temperature polymeric electrolyte fuel cells (PEMFCs) [1]. This work presents a combined approach, in which the membrane/electrode (MEA) assemblies are prepared in-house, while the design of the individual components and the whole stack takes place [2], in order to arrive at reliable and efficient units operating at high temperatures (180-190^{o}C). These systems provide electricity in the range of 0.5 to 5 kW and are applicable to cogeneration units (CHP), mobile and stationary auxiliary power units (APUs), battery chargers with LPG and power generation in off-grid areas.

The efficient operation of such devices presupposes the development of suitable materials and components for the heart of the stack, the MEAs, specifically polymeric electrolytes [3], electrocatalysts [4] and electrodes. The material and specific design of the bipolar plates in between the MEAs, as well as the sealing materials play critical role in the efficient performance and durability. Of great importance is also the design of the cooling system of the stack, which differs significantly and depends on the final application and the tolerance of the materials to the temperature difference along the devices. In addition, detailed mechanical and thermomechanical models have been developed for each component separately to predict the stress and strain fields, as well as to reduce the weight of the stack, with particular attention to the end plates to ensure uniform distribution of compression stresses exerted on the MEA assemblies.

An additional objective based on the aforementioned electrochemical devices, is the development of integrated CHP systems either operating with LPG/NG, or combined with water electrolysis (regenerative system). These can find application in homes, auxiliary power units, heavy vehicles or maritime transportation.

KEYWORDS: PEMFCs, Membrane-Electrode Assemblies, Bipolar plates, Fuel Cell Stacks

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