Journal of Power Sources

Volume 86, Issues 1â€“2, March 2000, Pages 111-116

Recent advances in direct methanol fuel cells at Los Alamos National Laboratory

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https://doi.org/10.1016/S0378-7753(99)00407-3

Abstract

This paper describes recent advances in the science and technology of direct methanol fuel cells (DMFCs) made at Los Alamos National Laboratory (LANL). The effort on DMFCs at LANL includes work devoted to portable power applications, funded by the Defense Advanced Research Project Agency (DARPA), and work devoted to potential transport applications, funded by the US DOE. We describe recent results with a new type of DMFC stack hardware that allows to lower the pitch per cell to 2 mm while allowing low air flow and air pressure drops. Such stack technology lends itself to both portable power and potential transport applications. Power densities of 300 W/l and 1 kW/l seem achievable under conditions applicable to portable power and transport applications, respectively. DMFC power system analysis based on the performance of this stack, under conditions applying to transport applications (joint effort with U.C. Davis), has shown that, in terms of overall system efficiency and system packaging

requirements, a power source for a passenger vehicle based on a DMFC could compete favorably with a hydrogen-fueled fuel cell system, as well as with fuel cell systems based on fuel processing on board. As part of more fundamental studies performed, we describe optimization of anode catalyst layers in terms of PtRu catalyst nature, loading and catalyst layer composition and structure. We specifically show that, optimized content of recast ionic conductor added to the catalyst layer is a sensitive function of the nature of the catalyst. Other elements of membrane/electrode assembly (MEA) optimization efforts are also described, highlighting our ability to resolve, to a large degree, a well-documented problem of polymer electrolyte DMFCs, namely â€œmethanol crossoverâ€. This was achieved by appropriate cell design, enabling fuel utilization as high as 90% in highly performing DMFCs.

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Keywords

Direct methanol fuel cell; Transport application; Portable power application; Methanol crossover

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