Reformed Hydrogen Fuel Cell System for Portable Power

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A reformed hydrogen fuel cell system with a high energy density and an easily replenishable fuel for a long duration power supply is being developed for portable power applications. A small fuel processor to convert liquid methanol fuel into hydrogen rich gas suitable for an elevated temperature (150-225°C) polymer electrolyte membrane (PEM) fuel cell was developed using the multilayer ceramic technology. The fuel processor consists of a fuel vaporizer, methanol steam reformer, and a catalytic combustor to provide heat for the steam reforming reaction. Using the ceramic micro reactor technology, all these components were integrated into a small fuel processor device. Hydrogen-rich output gas generated from this fuel processor contains less than 1% CO and it is suitable for operating a fuel cell based on phosphoric acid doped polybenzimidazole (PBI) polymer electrolyte membrane fuel cells at 150-225°C without CO clean up. Ceramic substrates to house the elevated temperature PEM fuel cell were also processed using the multilayer ceramic technology. Flow fields, current collectors, and thick film heaters were integrated into the ceramic substrate. The fuel cell was assembled by sandwiching the PBI–MEA (membrane electrode assembly) between two of these ceramic end plates. The ceramic fuel processor unit was thermally integrated with this fuel cell unit and enclosed with an insulator to evaluate the reformed hydrogen fuel cell system. This paper describes the processing and assembly of the ceramic fuel processor, elevated temperature fuel cell and the reformed hydrogen fuel cell system. Preliminary performance data of the integrated 1W fuel cell unit operating with the liquid methanol fuel input will be shown. Energy density and efficiency projections of the reformed hydrogen fuel cell system in the 1-20W ranges will be presented.