214b A Nanoporous Silicon Based Membrane Electrode Assembly for on-Chip Micro Fuel Cell Applications

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Silicon-based fuel cells are under active development for chip-scale electrical power supply. Such fuel cells are expected to be fabricated with the micro-devices they powered in an integrated process. One of the greatest challenges in micro-fuel cell research is the development of a suitable proton conducting membrane material that functions as the electrolyte and is compatible with standard silicon micro-fabrication technology. The widely used polymer membrane, Nafion membrane, is not suitable for that purpose due to its volumetric changes with changes in hydration level. In this paper the use of suspended nanoporous silicon membranes as a novel proton-conducting material in a microscale fuel cell membrane electrode assembly (MEA) is demonstrated. Using 5 M formic acid and 0.5 M sulfuric acid as the fuel, the micro fuel cell peak power density reached 31.5 mW/cm2 at current density level of 116.9 mA/cm2. These results represent the successful integration of a new class of proton conducting material into a micro-fabricated silicon-based fuel cell.