36d Si-Based Microfabricated Liquid Fuel Cell System Featuring High Aspect Ratio Micro-Pillars for Selective Electrocatalyst Deposition

Allen CH Feng, Guizhen Yan, Zhiyong Xiao, Philip CH Chan, and I.-Ming Hsing

Abstract

Although the power system market for the consumer electronics is largely dominated by the lithium polymer battery, liquid-fuel based micro fuel cells that offer high energy density and require no recharging have attracted many companies in the electronics and telecommunication sectors to develop this technology. In order for consumers to accept the fuel cell product, its system size and cell performance have to be made comparable to the lithium batteries and its polarization characteristics have to be stable over a long period of time.

In this study, a silicon/glass based micro fuel cell system fabricated by the micromachining technique will be presented. Inductively coupled plasma (ICP) etched micro-scale pillars that can be used to support noble-metal electrocatalysts and to facilitate the pumpless and capillary force driven liquid flow in a micro-environment will be highlighted (Figure 1a).

Most importantly, in this presentation a novel technique that enables the selective deposition of electrocatalytic metal particles on desired micro-column areas (e.g. vertical cylindrical surface) will be demonstrated. The selective deposition of electrocatalyst can be achieved by the mediated electropolymerization process of a conductive polypyrrole (PPY) and Nafion® film. Selective electrocatalyst deposition by a wet electroplating process can be done on the selective and conductive Si area covered by the conductive PPy/Nafion film (Figure 1b). Electrochemical measurements suggested that the electroplated catalysts on the micro-pillars have high active surface areas and should possess high catalytic activity in the micro fuel cell environment. This selective deposition method is very powerful and should be readily applicable to the other microfabricated fuel cell systems.

Figure 1a. Arrayed Micropillars Figure 1b. Selective Deposition of Pt Particles on PPy/Nafion coated micro-cylinder surface

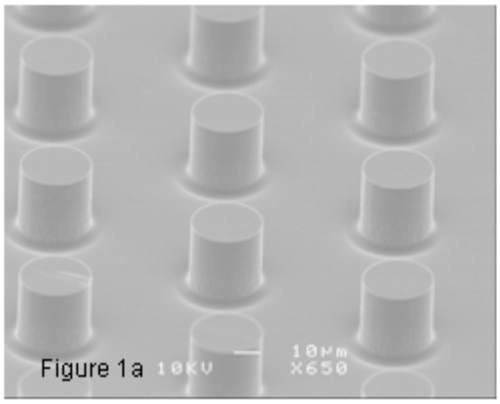

Figure 1a 10KV

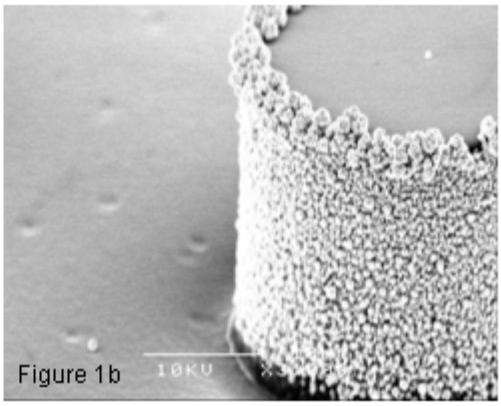
Figure 1b 10KV