MICRO FUEL CELL BASED ON THICK PHOTORESIST

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Micro fuel cells have been drawing increasing attention recently, especially in response to the high demand for power sources used in portable electronics. Approaches involving the adaptation of micromachining and microfabrication are not surprising given the ability to build fine features with exceptional accuracy[1-3]. Accordingly, silicon ─ which boasts the highest level of existing process development ─ has been a natural candidate material for micro fuel cell components, and flow structures in particular[2,3]. Some initial success has been demonstrated by such structure, and furthermore, fabrication capability of in-plane complex features have enabled novel planar multicell configurations, which may be more appropriate than vertical stacks in the case of miniature assemblies[3].

An interesting parallel field of research and development has been the development of microfluidic devices, especially for chemical and biological analysis. These include non-silicon microchannel devices that favor low cost and rapid prototyping. Among several available technologies, one of the most successful has been the fabrication of structural channels by photosensitive polymers and ultrathick photoresist[4-6]. Advances in photosensitive materials have enabled microchannel fabrication with high aspect ratio and the fine feature definition inherent to photolithography[7-9]. Epoxy-based resins have the additional benefits of mechanical stability and chemical resistance. Furthermore, some resist materials may be directly used as bonding agents, thereby offering a more integrated method of cell assembly[6,10].

This paper will explore the possibility of directly incorporating structural photosensitive materials in a miniature fuel cell. Figure 1 shows an example of simplified fabrication process flow. Through lithography technique, flow channels with fine feature size(<100μm) can be easily obtained. Figure 2 shows an example of reactant flow passages patterned in an ultrathick photoresist (SU-8). Prior to any functional optimization, performance issues and fundamental challenges such as materials compatibility and current collection will be discussed.

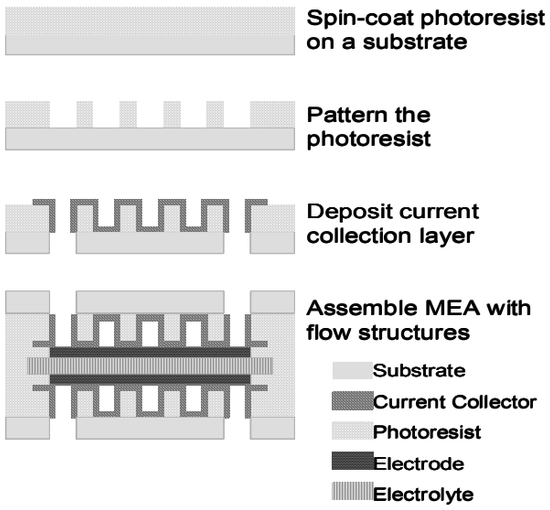

Figure 1. Fabrication process flow of a micro fuel cell with photoresist flow channels.

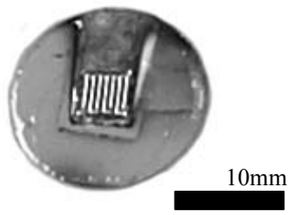

Figure 2. Micro fuel cell flow structure in glass substrate and photo-patterned thick photoresist(SU-8).

1. R. F. Savinell et al, *Micro-Power Sources*, The Electrochemcial Society Proceeding Series, Pennington, NJ (2000).
2. S. C. Kelley, et al,*Micro-Power Sources*, The Electrochemical Society Proceeding Series, Pennington, NJ (2000).
3. A. Chang-Chien et al, The Electrochemical Society, San Francisco, CA(2001)
4. P. Svasek et al, Proc. μTAS 96, Basel, CH(1996)
5. P. F Man et al, Proc. MEMS'97, Nagoya, Japan (1997)
6. J O'Brien et al, J. Micromech. Microeng., 11 (2001)
7. M. Despont et al, Proc. MEMS'97, Nagoya, Japan (1997)
8. H. Lorenz et al, Sensors and Actuator A, 64 (1998)
9. J. Zhang et al, J. Micromech. Microeng. 11 (2001)
10. R. J. Jackman et al, J. Mircomech, Microeng 11 (2001)