

Mechanical Engineering /College of Engineering and Applied Sciences

MECHANICAL ENGINEERING DEPARTMENTAL LECTURE

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Title: An Embedded Microfluidic Self-Pumping Structure for Micro Direct Methanol Fuel Cells

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Date: Thursday, March 22, 11:00AM room 301 of Engineering

Abstract

Abstract: Micro direct methanol fuel cells (μ DMFCs) are considered to be the next-generation power sources for portable electronic devices, such as cell phones, global positioning systems (GPS), digital cameras, and laptop computers. The potential advantages of μ DMFCs over conventional batteries include higher energy density, quicker recharging rate, and less pollution. Efficient liquid management in μ DMFCs is critical in minimizing the methanol cross-over problem. The traditional active liquid management subsystems not only consume considerable power but also claim a significant portion of volume from the system, thus hindering the future development of high-energy-density μ DMFCs. Aiming at replacing the current cumbersome liquid management subsystems and improving μ DMFCs' energy density, we are pioneering an integrated microfluidic approach that automatically regulates liquid and gas reactants with minimal or even no power consumption. This presentation focuses on the key technology of our approach: an embedded self-pumping mechanism that uses CO_2 gas bubbles, which are produced by the fuel cell reactions, to deliver the liquid fuel. Our technology requires no energy-consuming components (e.g., active pumps), self-regulates the pumping rate according to the system's power consumption, and removes CO_2 bubbles promptly through hydrophobic nanoporous membranes. By eliminating the need for discrete pumps and gas/liquid separators, our design is amenable to the further miniaturization of μ DMFCs. It must be emphasized that although our approach has only been tested on μ DMFCs, it can be easily extended to many other types of micro fuel cells that involve liquid reactants and gaseous products. The presentation will be concluded with a perspective on future research in microfluidics with applications to energy generation and biomedical engineering.

Biography

Dr. Dennis Desheng Meng received his B.E. (1998) and M.S. (2001) degrees from Tsinghua University, Beijing, China and Ph.D. degree (2005) in Mechanical Engineering from UCLA with an Outstanding Ph.D. Student Award. He is currently a postdoctoral researcher/lecturer in the Mechanical and Aerospace Engineering Department at UCLA and a member of IEEE and ASME. He has been conducting research on μ DMFCs in the UCLA Micro and Nano Manufacturing Laboratory directed by Professor C.-J. Kim. He also teaches a graduate-level class on MEMS fabrication at UCLA.

References:

- [1] D. D. Meng, J. Kim, and C.-J. Kim, "A degassing plate with hydrophobic bubble capture and distributed venting for microfluidic devices," *Journal of Micromechanics and Microengineering*, 2006, vol. 16, pp. 419–424.
- [2] D. D. Meng and C.-J. Kim, "Embedded Self-circulation of Liquid Fuel for a Micro Direct Methanol Fuel Cell" *Proc. IEEE Int. Conf. Micro Electro Mechanical Systems*, Jan. 2007, pp. 85–88. (selected for oral presentation)
- [3] D. D. Meng and C. J. Kim, "Method and Apparatus for Pumping Liquids Using Directional Growth and Elimination of Bubbles." U.S.A. Patent pending: 60/647,139, 2006