Bio-inspired Micro-Nano fluidic Systems

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There have been many fluidic related functional structures or devices employed by biological systems for fluid manipulation, flow regulation, or reaction control. In this short talk, two types fluidic related bio structures/devices will be introduced in micro or nano scale, and their inspirations for building artificial micro/nano fluidic systems will be elaborated. One of the systems is the surface of lotus leaf, which contains micro structures in tens of micro meters and nano structures in hundreds of nano meters. The combination of these two structures as well as their material properties enables the lotus leaf surface to have very high water contact angle (160°) and low hysteresis (10°), which can be used for slush rejection and fluid proof. Based on this concept, artificial lotus leaf has been fabricated by micro/nano fabrication technology and possesses a compatible high contact angle (160°) and even lower hysteresis (2.7°). This artificial surface will be employed for micro/nano droplet manipulation on surface for the application of digital fluidic systems without bio-fouling issue. The other example will be inspired by cell membrane surface with many functional proteins for ion or water regulation and signal channeling. Artificial membrane is thus formed on the edge of a thin nano holes and only limited/selected biomolecules will be manually addressed on the membrane surface for ion/molecule signaling or pumping. This artificial membrane can effectively separate fluids into at least two isolated compartment to regulate nano scale biochemistry reaction by locally exciting single protein molecule for quantized electron/photo/ion counting in nano scale.

Fan-Gang Tseng (曾繁根) received the B.S. degree in power mechanical engineering from National Tsing Hua University, Taiwan in 1989, and the M.S. degree from the Institute of Applied Mechanics in National Taiwan University, Taiwan, in 1991. In 1998, he received his Ph.D. degree in mechanical engineering from the University of California, Los Angeles, USA (UCLA), under the supervision of Prof. C.-M. Ho and C.-J. Kim. After one year with USC/Information Science Institute as a senior engineer working on a new microfabrication process, EFAB, he became an assistant professor with Engineering and System Science Department of National Tsing-Hua University, Taiwan from August, 1999, and advanced to associate professor in August, 2002, as well as full professor in August 2006. His research interests are in the fields of Bio-MEMS, Micro Fuel Cells, and Nano/Micro-Fluidic Systems. He received 30 patents, wrote 4 book chapters including "Micro Droplet Generators" in MEMS Handbook by CRC press and "Technological Aspects of Protein Microarrays and Nanoarrays" in Protein Microarrays by Jones and Bartlett Publishers, published more than 70 SCI Journal papers and 160 conference technical papers in MEMS, Bio-N/MEMS, Micro Fuel Cells, and Micro/Nano Fluidics related fields, and co-organized or co-chaired in many conferences including IEEE Nano 07, IEEE Nanomed 07, APCOT '06, ISMNT'06, IEEE NEMS'05, 06, 07, IEEE Transducers'01, '11, and IS^{3}M'00. He received several awards, including Mr. Wu, Da-Yo Memorial Award from National Science Council, Taiwan (2005), four best paper/poster awards (1991, 2003, 2004, and 2005), NTHU new faculty research award (2002), NTHU outstanding teaching award (2002), NTHU academic booster award (2001), and NSC research award (2000).