Nano-Pored Three-dimensional PDMS Microchip

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Recent advance of micro/nano device has been extensively shown the feasibility micro/nano energy conversion devices such as micro fuel cell, MEMS piezoelectric, photovoltaic cells, solar cells, and streaming potential [1]. Especially, streaming potential with nano-sized fluidic channel/pore exhibit physical behaviors not observed in larger structures and one can convert hydraulic energy to electrical energy. Importantly, the theoretical maximum power efficiency has been reported at around 12% using streaming potential and one can achieved theoretical values up to 35% efficiency at very high surface potentials in a 100 nm channel [2].

Here, we report the PDMS microchip with conical nano-pore fabricated on flexible materials such as PDMS by using focused ion beam (FIB). PDMS microchip with nano-pore could provide a platform both in protein preconcentration as well as energy harvesting device. Basically, all PDMS micro/nanofluidic device has great attraction because of its low cost, mass-produced, microfabrication compatible. In this presentation, we fabricated 100~500 nm sized cone shape nanopore on PDMS sheet by utilizing the focused ion beam (FIB). Then, we fabricated three-dimensional PDMS microchip with two reservoirs. The I-V characteristic with ion concentration polarization (ICP) was evaluated. For the energy harvesting application, the proof-concept of flexible energy conversion device is discussed.

References
[1] H. Daiguji, Chemical Society Reviews 39 (3), 901-911 (2010).
[2] Y. Ren and D. Stein, Nanotechnology 19, 195707 (2008).

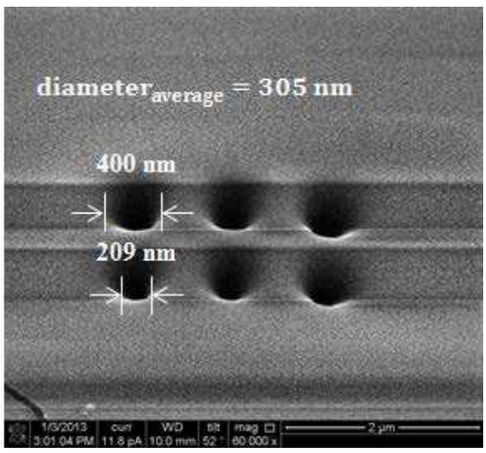
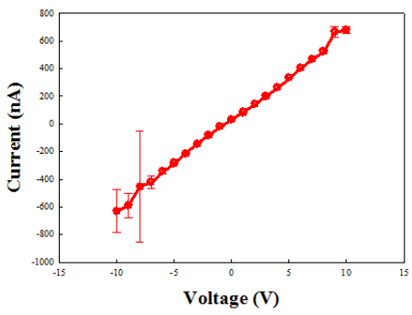


Figure 1. SEM image of nano-pore formed on PDMS sheet.

(a)



(b)

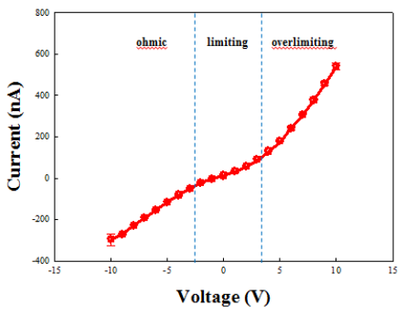


Figure 2. I-V curve of (a) microfluidic network and (b)micro-nano-microfluidic network, showing ion concentration polarization (ICP) via PDMS nanopore.