Electronic Supplementary Information

Nanoslit Membrane Integrated Fluidic Chip for Protein Detection Based on Size-Dependent Particle Trapping

Yul Koh‡[a], Homan Kang‡[b], Seung Hyun Lee[a], Jin-Kyoung Yang[c], Jong-Ho Kim[d], Yoon-Sik Lee*[bc], and Yong-Kweon Kim*[a]

[a] *School of Electrical Engineering and Computer Science, Seoul National University, Seoul 151-742, Rpublic of Korea. Fax: +82-2-880-XXXX; Tel: +82-2-880-XXXX; E-mail: yongkkim@snu.ac.kr*

[b] *Interdisciplinary Program in Nano-Science and Technology and Nano Systems Institute, Seoul National University, Seoul 151-742, Republic of Korea.*

[c] *School of Chemical and Biological Engineering, Seoul National University, Seoul 151-742, Republic of Korea; E-mail: yslee@snu.ac.kr*

[d] *Department of Chemical Engineering, Hanyang University, Ansan 426-791, Republic of Korea.*

‡ Y. Koh and H. Kang contributed equally to this work.

List of Contents

Numerical calculations of the hydraulic resistance of the horizontal nanochannel and the Nanoslit-Chip.

In case of horizontal nanochannel, the hydraulic resistance ($R_{hydraulic}$) is described as follows:

$$R = \frac{12\mu l}{1-0.63(h/w)}\frac{1}{h^3 w} \qquad (1)$$

where, μ is fluid viscosity; h, l, and w are height, length, and width of horizontal nanochannel, respectively. In order to compare with Nanoslit-Chip, we estimate the $R_{hydraulic}$ of horizontal nanochannel using the following values:
height (h) = 800 nm, width (w) = 1 mm, length (l) = 10 μm.

In case of Nanoslit-Chip, the hydraulic resistance ($R_{hydraulic}$) of the nanoslit membrane is described as follows:

$$R = \frac{12\mu d}{N(1-0.63(w/l))}\frac{1}{w^3 l} \qquad (2)$$

Because the hydraulic resistance of the nanoslit membrane is consisted of parallel nanoslit channels, $R_{hydraulic}$ is divided by the number of nanoslits (N) as shown in (2). We estimate the $R_{hydraulic}$ of nanoslit membrane using the following values:
nanoslit width (w) = 800 nm, length (l) = 18 μm, depth (d) = 2 μm, number of nanoslits (N) = 4300.

The volumetric flow rate ($Q_{flow\ rate}$) is calculated by $Q_{flow\ rate} = R_{hydraulic} \times P$. The volume flow rate of Nanoslit-Chip is about 1000 times larger than that of the horizontal nanochannel at the same pressure.

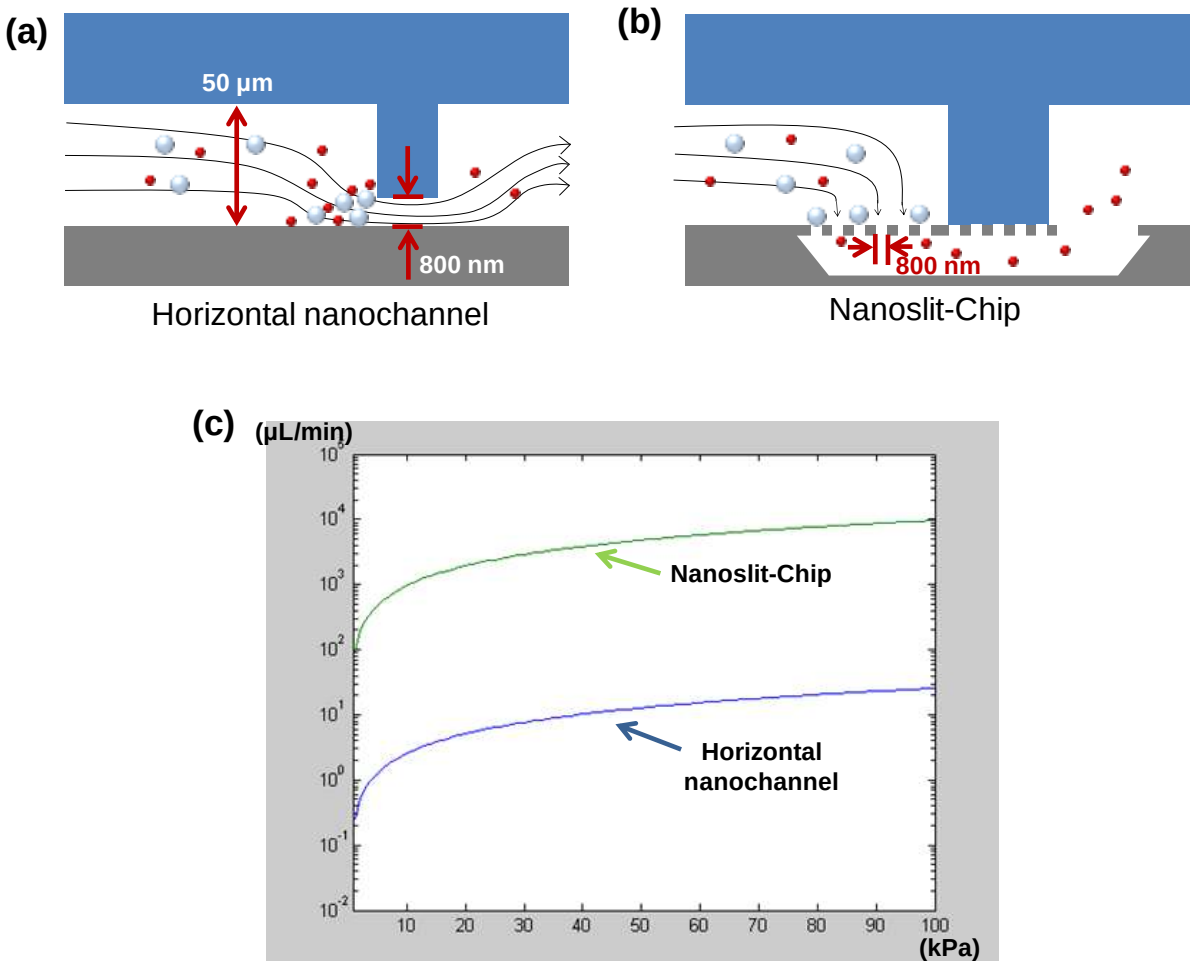

Figure S1. Schematic illustration for the cross section of (a) the horizontal nanochannel, and (b) the Nanoslit-Chip. (c) Volume flow rates of the horizontal nanochannel and the Nanoslit-Chip vs pressure (based on numerical calculation).

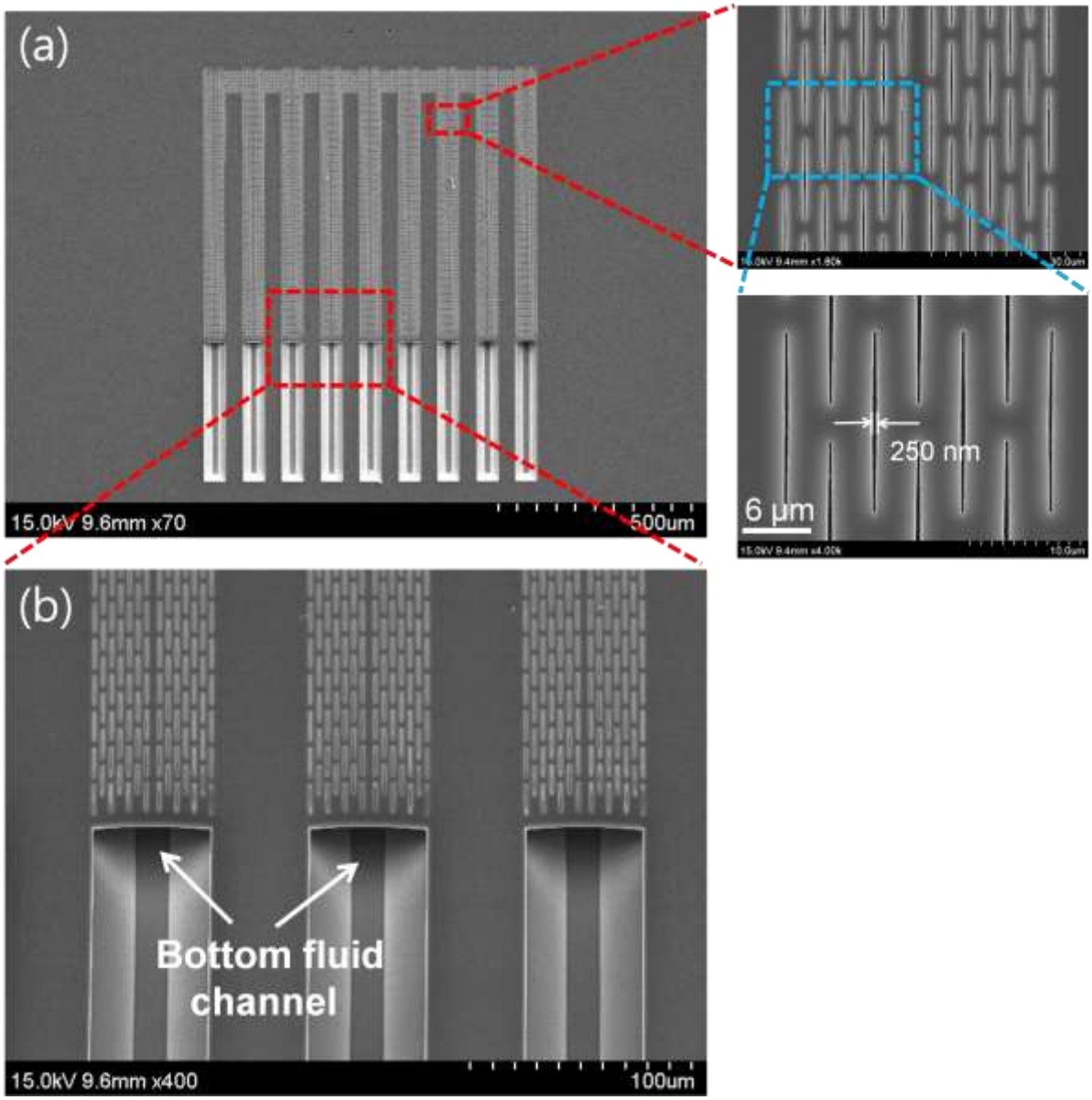

Figure S2. Fabrication results for the Nanoslit-Chip. SEM images show the whole nanoslit membrane and the bottom fluid channel. (a) About 4300 nanoslits are located in the membrane. The width of nanoslit was reduced up to 250 nm, which is a minimum slit size in our study. (b) The bottom fluid channels. The device was 30° tilted to show the bottom fluid channel under the membrane.

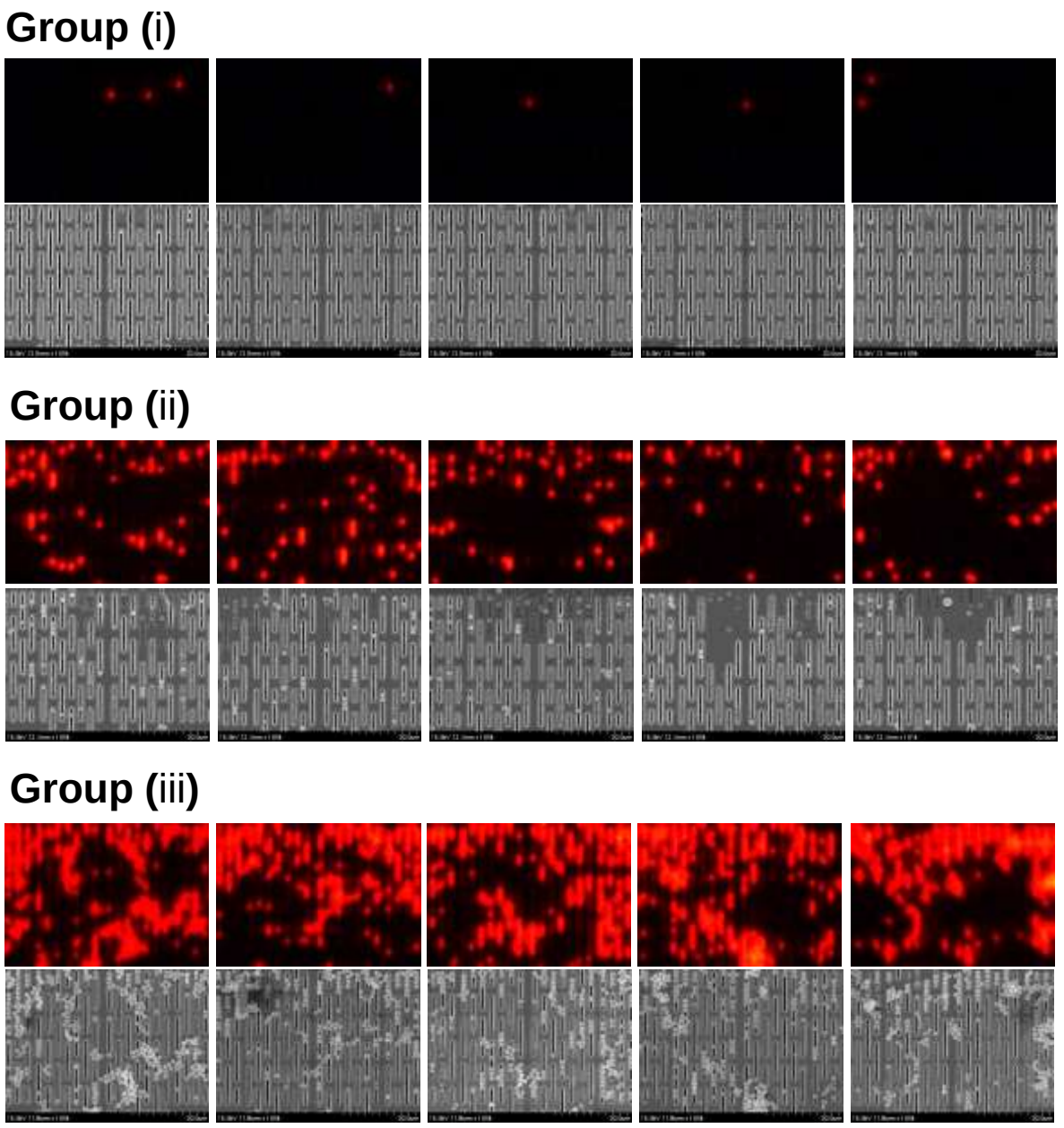

Figure S3. SEM images and the fluorescent images used for group (i), (ii), and (iii). The images were compared to study the correlation between the results of fluorescent detection and the number of particles on the nanoslit membrane.

Electronic Supplementary Material (ESI) for Lab on a Chip

Movie S1. Trapping the 1.8 μm red fluorescent particles on the membrane. The 1.8 μm red fluorescent particles (particle concentration was 10^5/ml) were injected to the Nanoslit-Chip at a flow rate of 40 μl/min and detected by fluorescence microscopy during the particle trapping. Red signals were continuously increased by the fluid injection and almost all the nanoslits at the trapping region were filled with the red fluorescent particles.