Electronic Supplementary Material (ESI) for Lab on a Chip.


# Supporting Information

**On-Demand Micro/Nano-Convertible Channel using Elastomeric Nanostructure for Multi-Purpose Use**

## S1. Pushrod Setup

Figure S1 (a) is the picture of the device to induce the deformation of the elastic channel and the nanostructure for the on-demand convertible channel. By manual adjustment of the X and Y axis stage, the pushrod can be placed, where microchannel and nanostructure are, to convert the channel mode. The degree of deformation can be determined by pressure or displacement. In this research, we used the displacement to control the deformation because actual deformation, induced by the pressure, will vary by the elasticity thus it is relatively hard to control. Therefore, regardless of changes in elasticity, the deformation can be determined by displacement uniformly. The pushrod made of acrylic is fixed on the motorized z-axis stage hooked up with a computer to push the convertible channel precisely. The shape of the pushrod head is easily formed by a laser cutting technique. As shown in Figure S1 (b), the convertible channel with the deformation applying device was mounted on the fluorescence microscope (Olympus IX-71, Japan) for an observation.

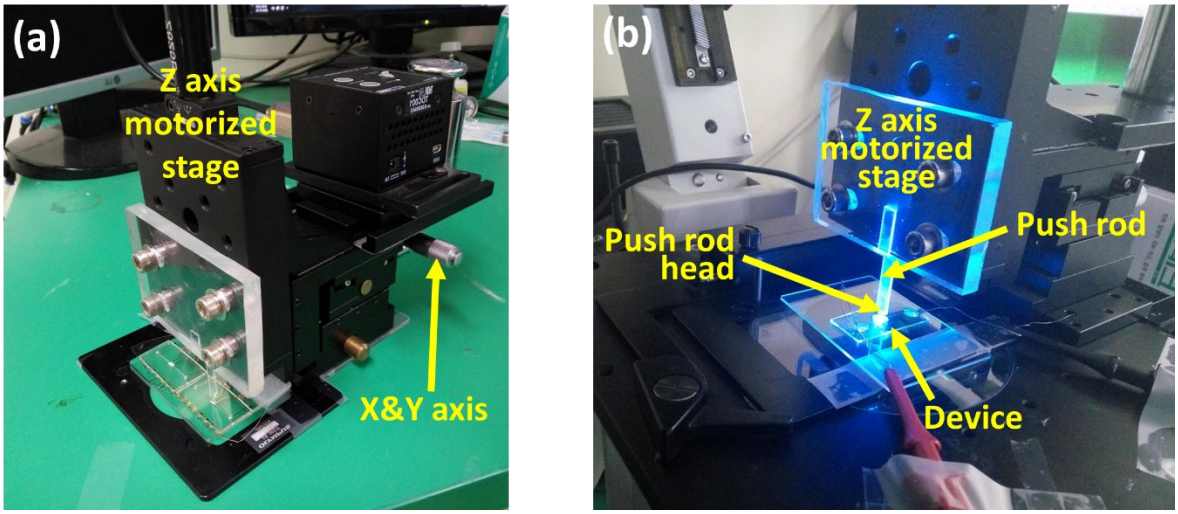


**Figure S1.** Images showing the experimental setup. (a) The pushrod is translated along the z-axis by a motorized stage for accurate pushing. The pushrod head determines the pressure distribution on the elastic nanostructure. (b) The mounting of the device on the fluorescence microscope for observation.

**S2. Visualization of PNA immobilization**

In order to verify and quantify the red-fluorescence-tagged PNA immobilization on the surface of the electrospun fiber, we took fluorescence microscopy images (Olympus IX-71, Japan) of the electrospun nanostructure. The intensity of the red fluorescence indicates the degree of immobilization. As shown in Figure S2, the bare electrospun nanostructure shows low intensity which is just autofluorescence. 1-ethyl-3-(3-dimethylamonipropyl) carbodiimide (EDC) and N-hydroxysuccinimide (NHS) are widely known as a covalent link agent to enhance the immobilization. PNA immobilization with EDC+NHS (b) shows a much stronger fluorescence intensity than without EDC+NHS (c). The result indicates that the PNA is immobilized more effectively on the surface of electrospun fiber with EDC+NHS.

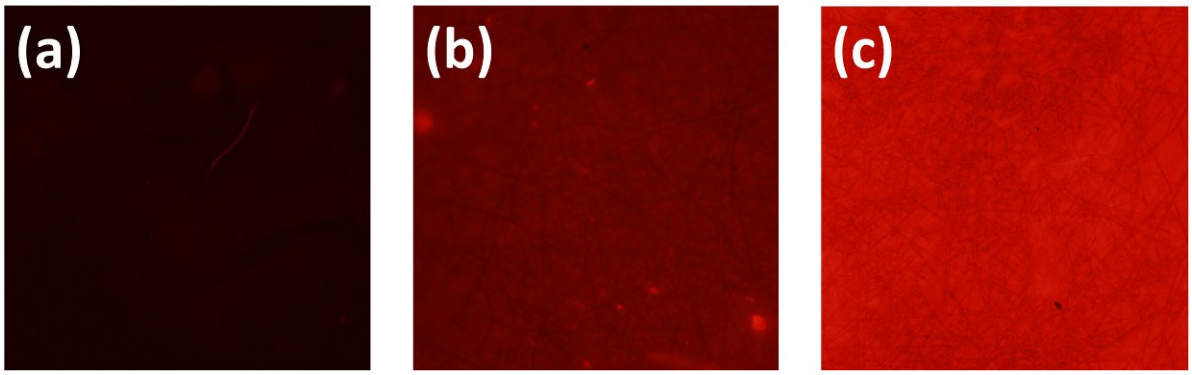


**Figure S2.** Verification for the immobilization of fluorescence-tagged PNA. (a) Bare electrospun nanostructure. Immobilization of PNA on electrospun nanostructure (b) without and (c) with EDC + NHS.

**S3. Pore size analysis based on ionic resistance**

In the elastic convertible channel, pore size is hard to be measured optically due to its small size. Especially, the nano-sized pore on the surface of the cut section, which is observed with electron microscopy, cannot represent actual pore size inside the channel mainly due to the elastic property. Therefore, we carried out the pore size analysis simply by Ohm's law. With the higher ionic strength solution, the ionic resistance is linearly proportional to the cross-sectional area. First, the micropore size that can be measured precisely is measured with an electron microscope as a reference. Second, with 1 M KCl solution, the ionic resistance was investigated as a function of the displacement step of the pushrod. Lastly, the ionic resistance can be converted to pore size based on the previously measured reference. Figure S3 plots pushrod displacement step versus pore size for the convertible channel, indicating the pore size can be adjusted from 51 μm to 4.3 nm.

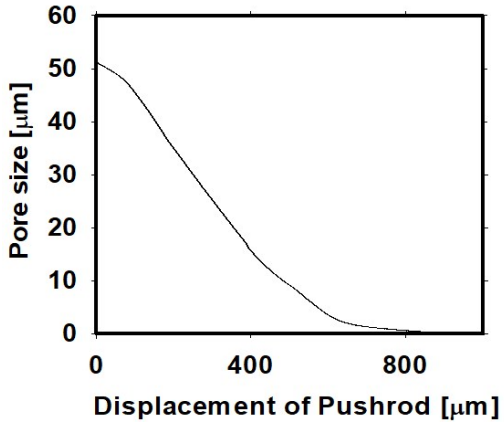


**Figure S3.** Pore size as function of displacement of pushrod, indicating the pore size of nanostructure can be adjusted from 51 um to 4.3 nm.

**S4. Comparison with other nanochannel based DNA sensors**

| Sensing type | Material of nanochannel | Sensitivity | Reference |
|---|---|---|---|
| Ionic impedence | A nanoporous alumina membrane | 5 μM | [1] |
| Ionic conductance | A cornical PET channel | 1 μM | [2] |
| Ionic conductance of marker ion | A nanoporous alumina membrane | 1 nM | [3] |
| Ionic conductance | An elastic polyurethane nanostructire | 10 nM | This work |


1 X. Wang and S. Smirnov, *ACS Nano*, 2009, **3**, 1004–1010.

2 M. Ali, R. Neumann and W. Ensinger, *ACS Nano*, 2010, **4**, 7267–7274.

3 S. J. Li, N. Xia, B. Q. Yuan, W. M. Du, Z. F. Sun and B. Bin Zhou, *Electrochim. Acta*, 2015, **159**, 234–241.