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## **Supplementary Information**

## Low cost 3D microfluidic chips for multiplex protein detection based on photonic crystals beads

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Fig.S1 Microfluidic chips (customized from Dolomite) and setup for droplet generation.



**Fig.S2** SEM images of chip channels. (a) high-magnification image (b) (c) low magnification image of the red part of (a). Silica nanoparticles can densely cover the adhesive inside the channel.



**Fig. S3** Immobilization ways of microspheres at the porous, where R is the bead's radius and L is half of the side length of a hole. (a)(c) the microspheres are unfixed (R>68 $\mu$ m, L=60  $\mu$ m), (b)(d) the microspheres are fixed. (60 $\mu$ m<R<68 $\mu$ m, L=60  $\mu$ m). Scale bar: 60  $\mu$ m.



**Fig.S4** Microbeads fabricated by droplet template method. (a)Image of photonic crystal microsphere by metallographic microscope. Scale bar:60  $\mu$ m. (b) Percentage of 60~64  $\mu$ m beads by droplet template method. (c) Beads with blue, green and red colors have different reflection peaks, which is 425 nm, 570 nm and 640 nm, respectively. These three different photonic microbeads composed of 168, 235, and 271 nm silica particles.(d)(e)(f) were SEM images of PCBs. (d)high-magnification image, (e)(f) low-magnification image.

Literature	Method	Materials	LOD	Cost	Reference
Microchimica Acta, 2017, 184(8): 2767- 2774.	ELISA	MnO <sub>2</sub> NPs	22 pg·mL <sup><math>-1</math></sup>	High	S1
Biosensors and Bioelectronics, 2017, 87: 352-357.	Electrochemistry	biotinylated lens culinaris agglutinin- integrated silver nanoparticles	12 pg⋅mL <sup>−1</sup>	High	S2
ACS applied materials & interfaces, 2013, 5(10): 4479-4485.	Differential pulse voltammetry	metal sulfide nanolabels and a silver nanocluster	$0.8 \text{ pg} \cdot \text{mL}^{-1}$	High	S3
Analytica chimica acta, 2016, 939: 84-92.	Fluorescence	Fluorescence- encoded magnetic microbeads	200 pg·mL <sup><math>-1</math></sup>	Low	S4
Biosensors and Bioelectronics, 2017, 91: 431-435.	Fluorescence	Photonic crystal fiber	$0.1 \text{ ng} \cdot \text{mL}^{-1}$	High	S5
Our method	Fluorescence	PCBs chip	$18.92 \text{ ng} \cdot \text{mL}^{-1}$	Low	

## Table S1. Comparison of limit of detection between different methods.

S1.Li Y, Wu J, Zhang C, et al. Microchimica Acta, 2017, 184(8): 2767-2774.

S2.Li J, Gao T, Gu S, et al. Biosensors and Bioelectronics, 2017, 87: 352-357.

S3.Zhang B, Liu B, Zhou J, et al. ACS applied materials & interfaces, 2013, 5(10): 4479-4485.

S4.Gong X, Yan H, Yang J, et al. Analytica chimica acta, 2016, 939: 84-92.

S5.Liu X, Song X, Dong Z, et al. Biosensors and Bioelectronics, 2017, 91: 431-435