

Supporting Information

Dynamic Liquid Surface Enhanced Raman Scattering Platform Based on Soft Tubular Microfluidics for Label-Free Cell Detection

Xiaoding Xu,^{†,#} Lei Zhao,^{†,#} Qilu Xue,[†] Jinkun Fan,[†] Qingqing Hu,[†] Chu Tang,[†] Hongyan Shi,^{*,†,§}

Bo Hu,^{*,†} Jie Tian,^{*,†,‡}

[†]School of Life Science and Technology, Xidian University, Xi'an, Shaanxi 710126, P. R. China

[‡]Institute of Automation, Chinese Academy of Sciences, Beijing 100190, P. R. China

[§]Kunpad Communication Pty. Ltd., Kunshan, Jiangsu 215300, P. R. China

[#]These authors contributed equally to this work.

Corresponding Authors

*E-mail: bohu@xidian.edu.cn (B.H.).

*E-mail: hyshi@xidian.edu.cn (H.S.).

*E-mail: jie.tian@ia.ac.cn (J.T.).

Table of contents

1. The comparison between the Raman spectrum of quartz capillary and the SERS spectrum of 4-MBA
2. The Computational Fluid Dynamics (CFD) simulation of the mixing process inside the shaped tube
3. The characterization of silver nanostars
4. The comparison of initial cell suspensions and eluates
5. The pre-treatment of raw spectra
6. The independent experiments of cell identification

1. The comparison between the Raman spectrum of quartz capillary and the SERS spectrum of 4-MBA

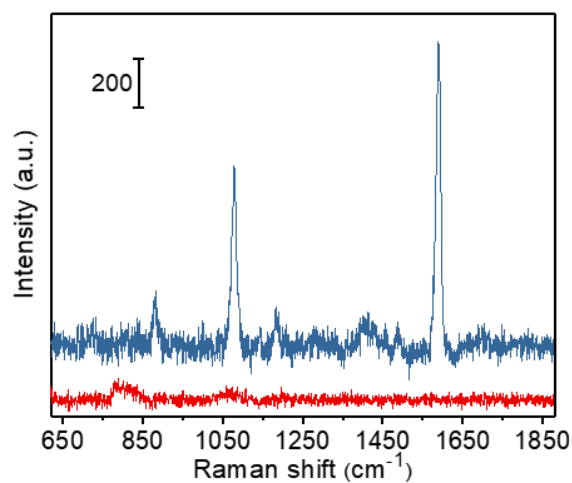


Figure S1. A comparison of Raman spectrum of quartz capillary (red) and 4-MBA SERS spectrum measured by chip (blue).

2. The Computational Fluid Dynamics (CFD) simulation of the mixing process inside the shaped tube

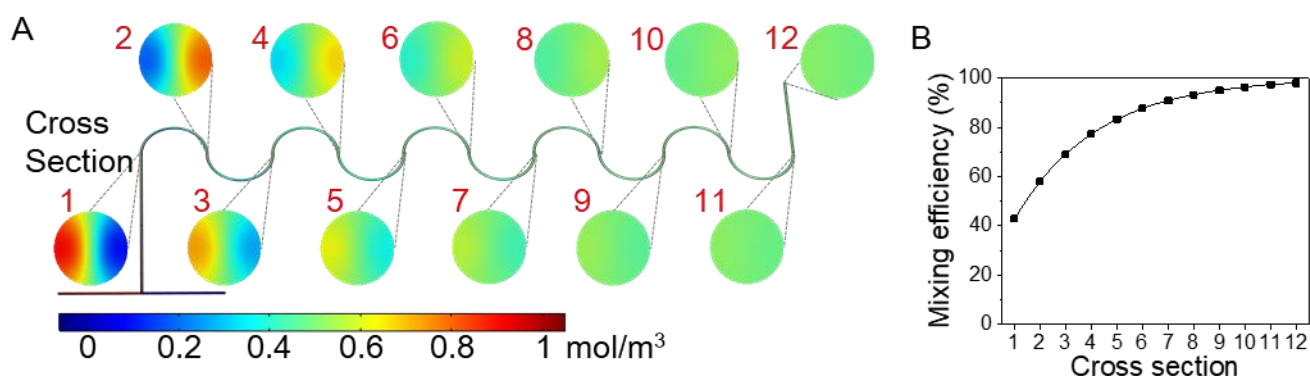


Figure S2. The Computational Fluid Dynamics (CFD) simulation of the mixing process inside the shaped tube. The concentrations of two inlets were set as 0 and 1 mol/m³. The flow rate of each inlet was set as 18 μ L/min. (A) The concentration distribution of the tube and the selective cross sections. The 12th cross section was the outlet. (B) Simulated mixing efficiencies versus cross sections. The mixing efficiencies were calculated as described by Enders et al¹.

3. The characterization of silver nanostars

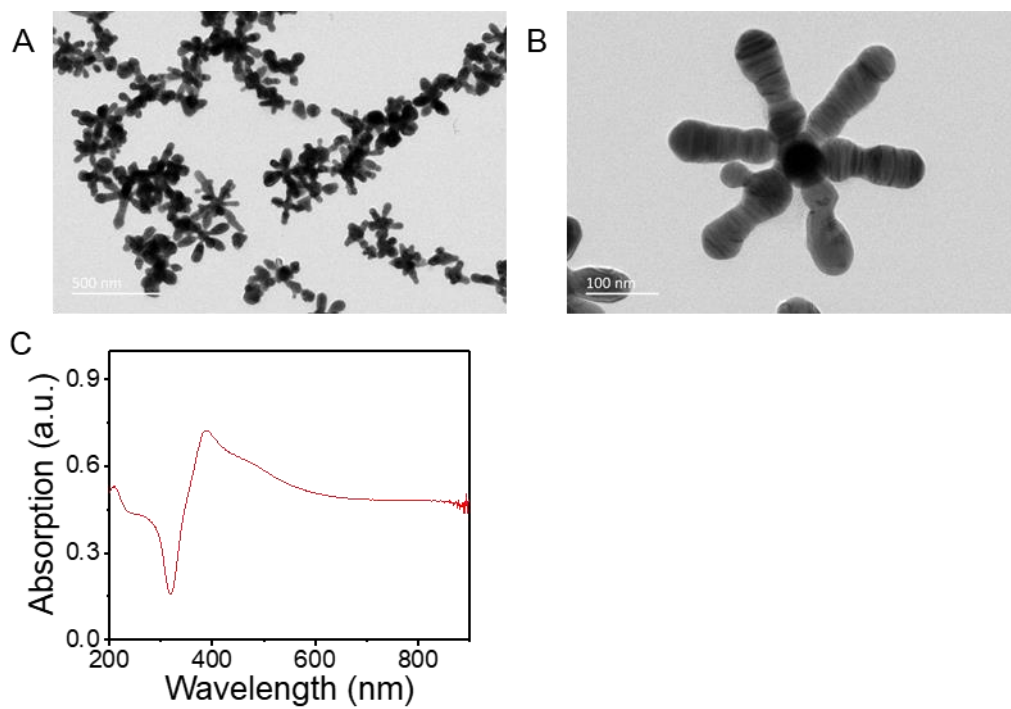


Figure S3. (A), (B) TEM images of the silver nanostars. (C) UV-vis absorption spectrum of silver nanostars solution.

4. The comparison of initial cell suspensions and eluates

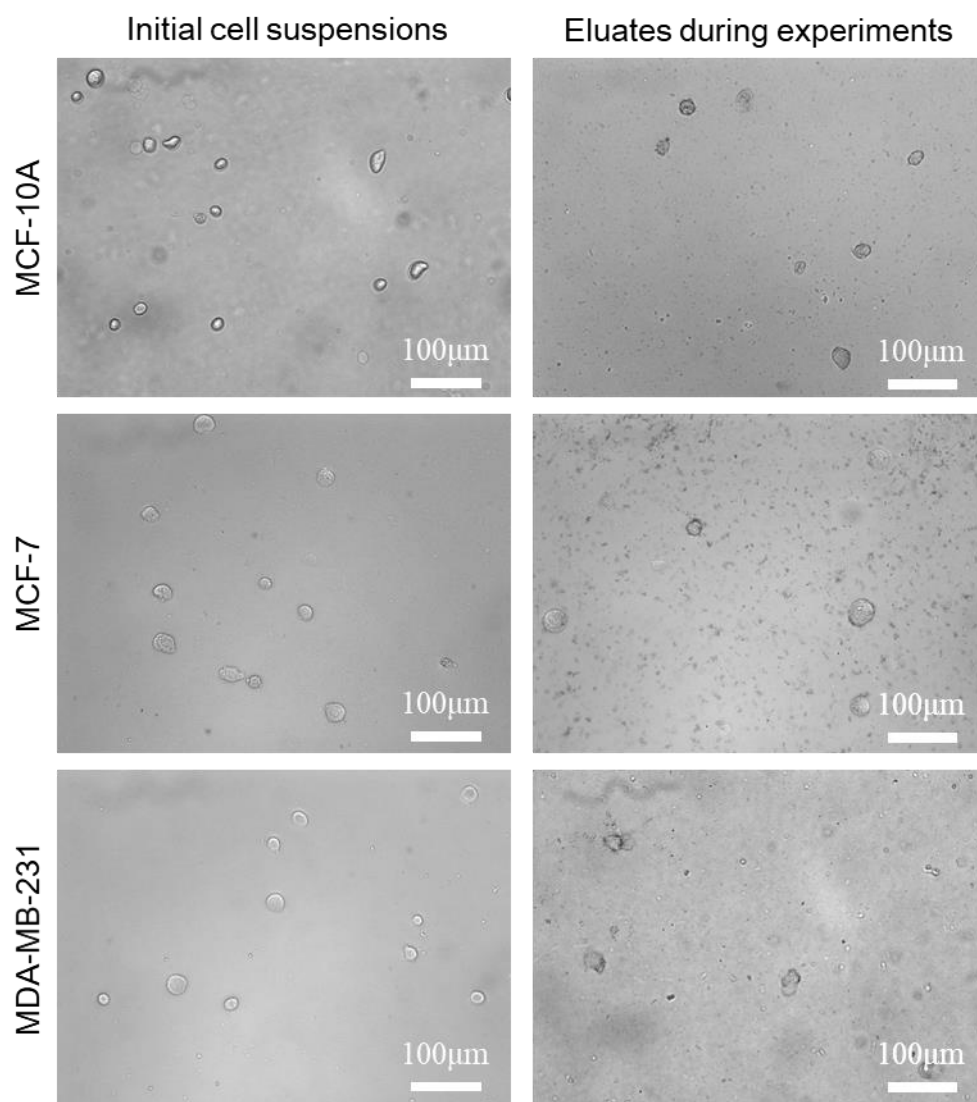


Figure S4. Microscopic photographs of the initial cell suspensions and the eluates during the experiments.

5. The pre-treatment of raw spectra

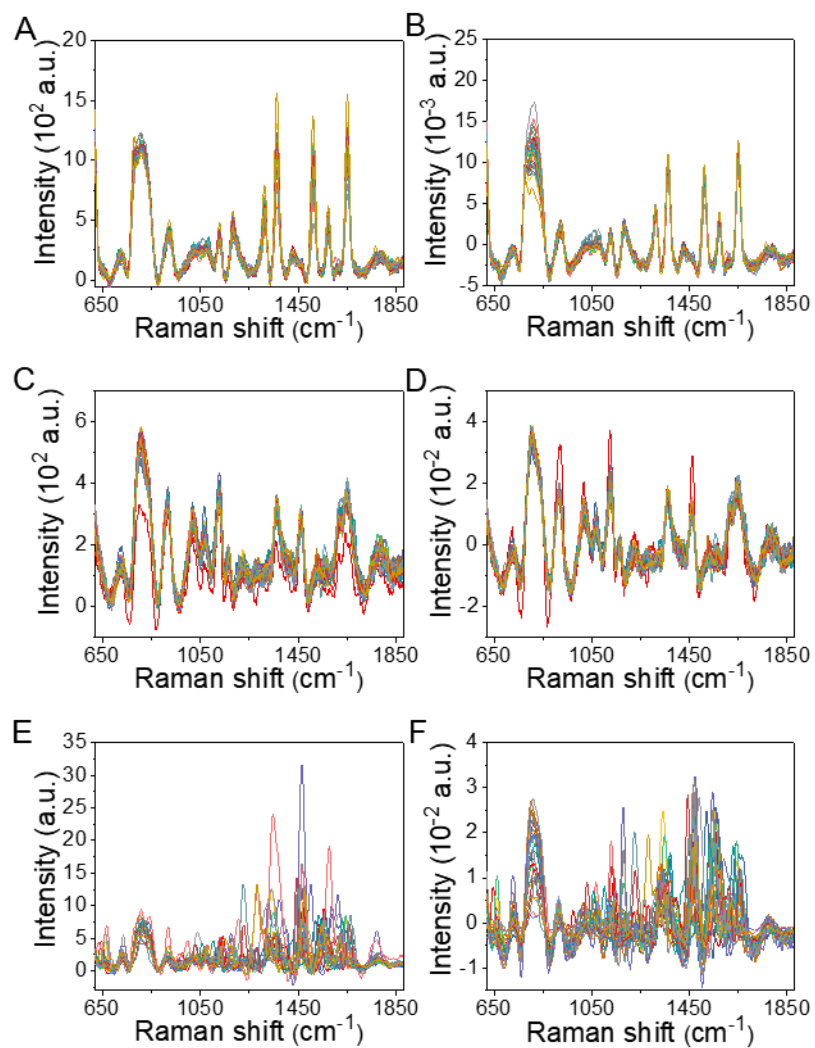


Figure S5. (A), (C), (E) the smoothed spectra of MCF-10A, MCF-7 and MDA-MB-231, respectively. (B), (D), (F) the standardized spectra of MCF-10A, MCF-7 and MDA-MB-231, respectively. (n=30)

6. The independent experiments of cell identification

A

Actual labels	Predicted labels			
		MCF-10A	MCF-7	MDA-MB-231
	MCF-10A	55	0	5
	MCF-7	0	60	0
	MDA-MB-231	3	1	56

B

Actual labels	Predicted labels			
		MCF-10A	MCF-7	MDA-MB-231
	MCF-10A	52	3	5
	MCF-7	0	60	0
	MDA-MB-231	5	0	55

Figure S6. Confusion matrixes of the K-NN classification model for two independent experiments. (A) Overall accuracy was 95%. (B) Overall accuracy was 92.8%.

Table S1. The accuracy, sensitivity and specificity of each independent experiment

No.	Accuracy	MCF-10A		MCF-7		MDA-MB-231	
		Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
1	94.4%	100%	91.7%	100%	100%	83.3%	100%
2	95%	91.7%	97.5%	100%	99.2%	93.3%	95.8%
3	92.8%	86.7%	95.8%	100%	97.5%	91.7%	95.8%

REFERENCES

- (1) Enders, A.; Siller, I. G.; Urmann, K.; Hoffmann, M. R.; Bahnemann, J. *Small* **2019**, *15* (2), 1804326.