In situ phenotype profiling and identification of circulating tumor cells in a microfluidic chip using multiplex SERS nanoprobes

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Abstract:

Circulating tumor cells (CTCs) are emerging as a promising liquid biomarker for assessing the therapeutic efficacy and prognosis of cancer. Although there are lots of reports on the isolation and enumeration of CTCs in blood, the research on analyzing the phenotypic information of the isolated cell is still at its infancy. Recently, increasing evidences demonstrate that CTCs are heterogeneous in phenotype. Therefore, monitoring the phenotypic distribution of CTCs at the resolution of individual cells could be more adaptable to predict disease progression and therapeutic efficiency.

Here, to *in situ* profile cell membrane proteins and identify cancer subpopulations, an on-chip strategy which combines size-based microfluidic cell isolation with multiple spectrally orthogonal surface enhanced Raman scattering (SERS) analysis has been developed. By employing a revised classic least square (rCLS) algorithm, the 3D phenotypic information of captured individual CTCs was readily obtained on the basis of their composite SERS signatures. Significantly, with the help of categorization algorithm (PLS-DA), cells from different human breast cancer subtypes can be reliably classified with high sensitivity and selectivity. Moreover, this SERS-based CTC analysis platform could be extended to real samples for determining the subpopulations of the user-blinded tumor cells in blood. Our results demonstrate that this SERS-based microfluidic platform can be reliably used to identify the clinically relevant surface receptors using spectral information and holds a great potential in facilitating clinical cancer diagnosis.

Image

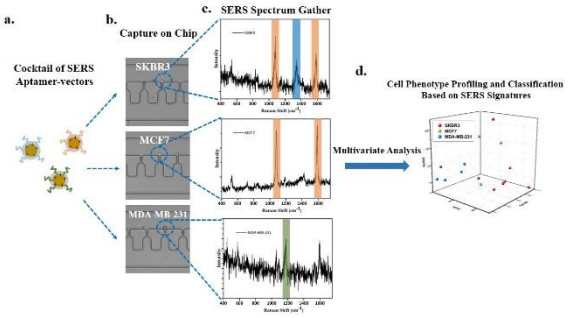
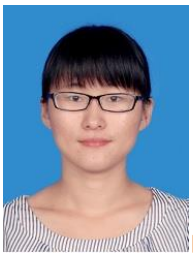


Figure. 1 The workflow of the SERS-based cell phenotype profiling strategy.

Recent Publications

1. Zhang Y, Wang Z, Wu L, Zong S, Yun B, Cui Y. Dual peptides modified fluorescence-SERS dual mode imaging nanoprobes with improved cancer cell targeting efficiency. RSC Advances. 2016; 6(84):81046-52.
2. Zhang Y, Wang Z, Wu L, Pei Y, Chen P, Cui Y. Rapid simultaneous detection of multi-pesticide residues on apple using SERS technique. Analyst. 2014; 139(20):5148-54.
3. Wu L, Wang Z, Zhang Y, Fei J, Chen H, Zong S, et al. In situ probing of cell-cell communications with surface-enhanced Raman scattering (SERS) nanoprobes and microfluidic networks for screening of immunotherapeutic drugs. Nano Research. 2017; 10(2):584-94.
4. Fei J, Wu L, Zhang Y, Zong S, Wang Z, Cui Y. Pharmacokinetics-on-a-Chip Using Label-Free SERS Technique for Programmable Dual-Drug Analysis. ACS sensors. 2017; 2(6):773-80.
5. Zong S, Chen C, Zhang Y, Li L, Wang Z, Cui Y. An innovative strategy to obtain extraordinary specificity in immunofluorescent labeling and optical super resolution imaging of microtubules. RSC Adv. 2017; 7(63):39977-88.



Biography (150 word limit)

Yizhi Zhang is currently a PhD candidate in Advanced Photonics Center, School of Electronic Science and Engineering, Southeast University. She obtained her bachelor degree in engineering from School of Electronic Science and Engineering & Chien-Shiung Wu College, Southeast University in 2014. Her research interests include SERS-based nanobiosensors and microfluidic platforms. She has published 10 research papers and has delivered several oral presentations on international conferences.

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NOTES/ COMMENTS