Surface-enhanced Raman spectroscopy method realizes quantitative detection of anticancer drugs in serum

March 23 2022, by Zhang Nannan

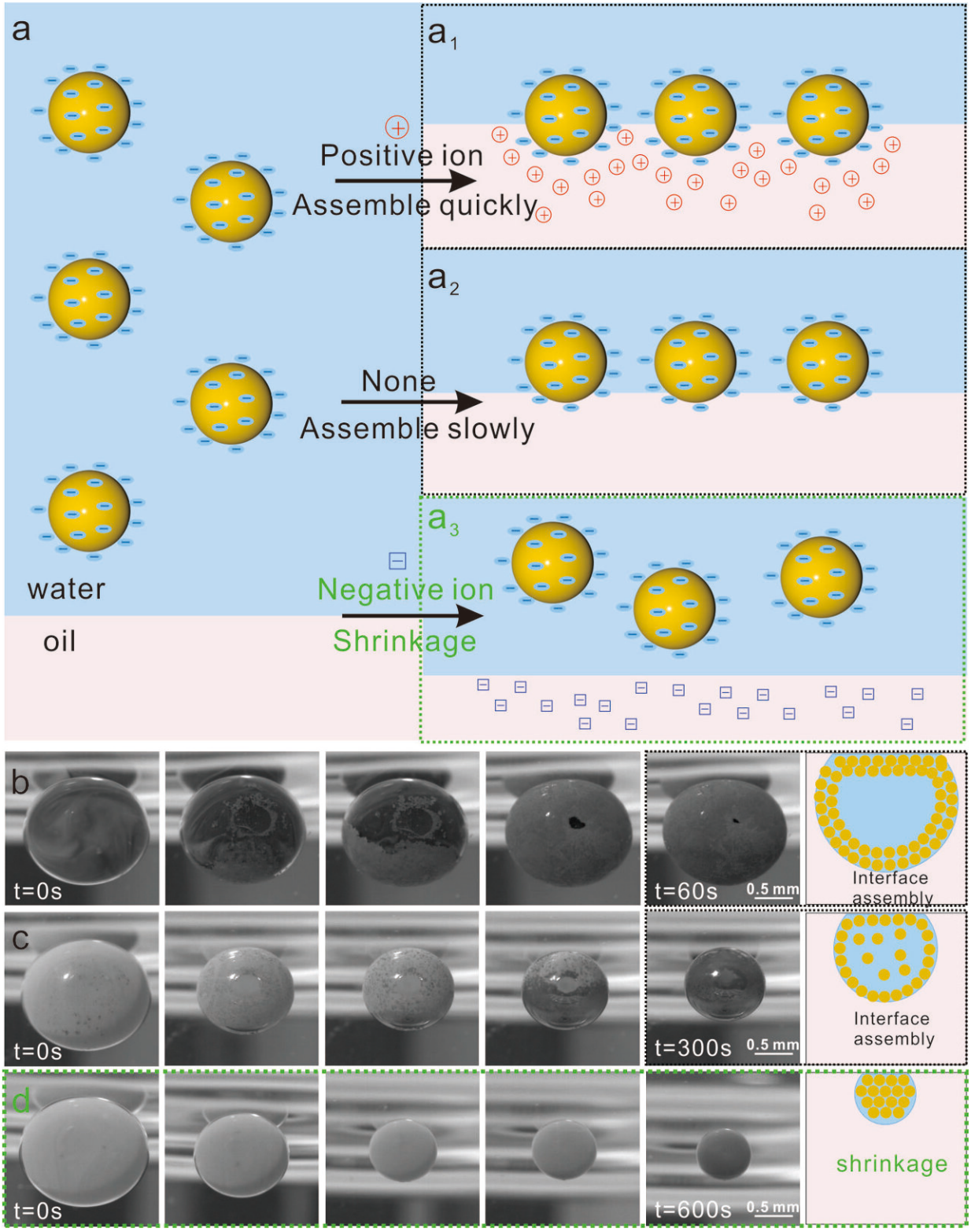

Figure 1. Schematic diagram of 3D hotspot matrix formation. Credit: Zhou Guoliang

Using the shrink-assembled liquid three dimensional (3D) hot spot matrix as a microreactor, a new method for quantitative detection of blood drug concentration by surface-enhanced Raman spectroscopy (SERS) was developed by researchers led by Prof. Yang Liangbao and Prof. Wang Hongzhi from the Hefei Institutes of Physical Science (HFIPS) of the Chinese Academy of Sciences (CAS), with high stability and sensitivity.

Results were published in *Analytical Chemistry*.

Quantitative detection is one of the ultimate goals of SERS methods, but there have been challenges in controlling the homogeneity of the hot spot and the entry of target molecules into the hot spot region.

Prof. Yang Liangbao's team has been engaged in the research work on the principle and detection application of SERS method for years, which is a type of fast, highly sensitive, and fingerprinted molecular spectroscopy. A series of achievements have been made with SERS in their previous work, including detection of poisons in oily matrix, and actively capturing target molecules in small gaps based on nano-capillary pumping model.

In this work, the researchers used the liquid three-phase equilibrium principle to control the shrinkage of droplets, which not only forms a high-density and highly stable liquid 3D hotspot matrix, but also enables antitumor drugs to enter the hotspot region autonomously.

Then, with a self-made effectively hand-held Raman spectrometer, they realized, for the first time, the online quantitative detection of anticancer drugs in the serum of tumor patients.

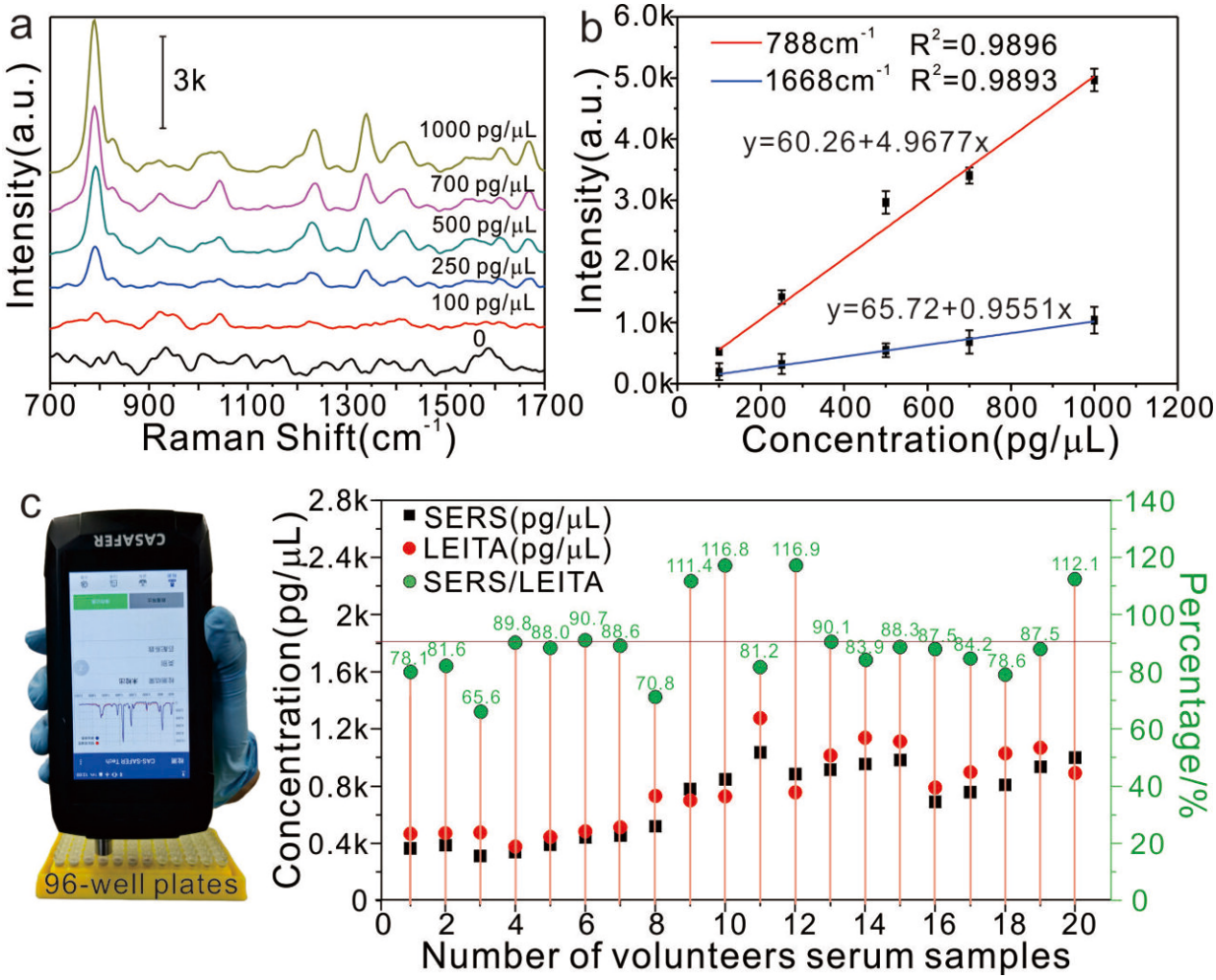

Figure 2. Detection of 5-fluorouracil in serum by hand-held Raman spectrometer. Credit: Zhou Guoliang

The method exhibited 50 ppb sensitivity for the anticancer drug 5-fluorouracil, and the quantitative detection range is 50–1,000 ppb.

Compared with traditional solid nanoarrays and colloidal aggregation SERS methods, the shrink-assembled liquid 3D hotspot matrix can enhance the enrichment ability of analytes in the plasmonic hotspot

space, enabling highly sensitive and stable SERS quantitative detection.

"It has great potential for quantitative detection of analytes in complex samples like serum, biological fluids, dynamic monitoring of anticancer drug metabolism processes and biochemical reaction kinetics," said Prof. Yang.

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More information: Guoliang Zhou et al, Controlling the Shrinkage of 3D Hot Spot Droplets as a Microreactor for Quantitative SERS Detection of Anticancer Drugs in Serum Using a Handheld Raman Spectrometer, *Analytical Chemistry* (2022). DOI: 10.1021/acs.analchem.2c00071

Provided by Chinese Academy of Sciences