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SERS-based optofluidic platforms and spectromics for health applications

In the past 20 years, the microfluidics community developed extremely advanced systems able to perform almost any chemical and/or biological lab protocol. However, to develop integrated lab-on-a-chip diagnostic platforms, it is crucial to couple microfluidic devices with detection strategies able to match the inherent properties of microfluidics: high-throughput, automation and miniaturisation.[1] One of those detection techniques is surface-enhanced Raman scattering (SERS) spectroscopy, an ultrasensitive and highly selective analytical technique with multiplexing ability. Despite all its advantages, the struggle of SERS in translational medicine and its transfer into clinics may be based on many factors, including, but not limited to, the cost and reproducibility of SERS substrates and the lack of standardization and benchmarking of SERS platforms. The integration of SERS with microfluidics allows miniaturisation and automation, reducing acquisition times and inter-test variability for complex biological samples analyses. [2] We have shown how the integration of different SERS sensing substrates and strategies within microfluidics and microdroplets offers a great flexibility for the diagnosis of several biological species and/or events. In this talk, I will show examples demonstrating the potential of SERS-based optofluidic platforms for single cell multiplex phenotypic analysis, for the differentiation of cancer versus healthy cells or for the metabolomic analysis for metastasis prediction.[3] These approaches may be transferred to different analytical fields, such as the detection and discrimination of foodborne pathogens, bacteria or viruses in food or water samples.

References

[1] Kant, K., & Abalde-Cela, S. (2018), Biosensors, 8(3), 62.
[2] Kant, K. et al., (2024), Nanoscale Horizons, in press.
[3] Oliveira, K. et al, (2023), 11, 2201500.

Figures

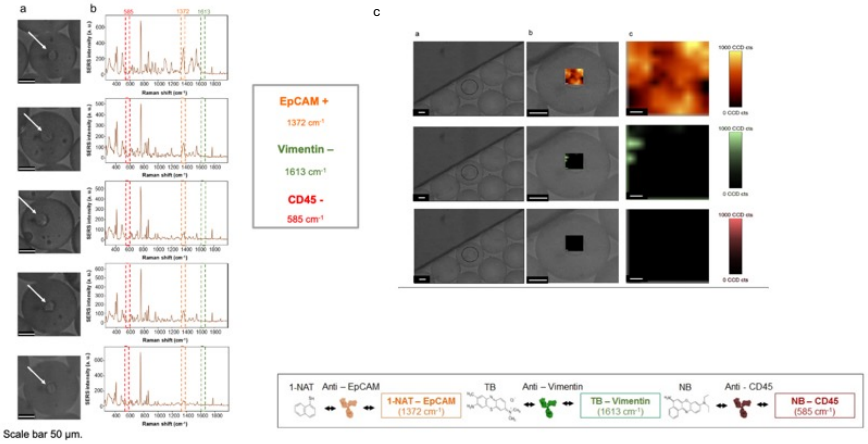

Figure 1: SERS-based phenotypic detection of isolated single cancer cells in microdroplets and multiplex analysis for the presence/absence of cell membrane proteins and corresponding cell surface intensity mapping for protein expression distribution.