SERS and microdroplets for multiplex phenotyping of cancer single cells

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The reason behind the high mortality of cancer is that it is a heterogeneous and dynamic disease, and that an average of 60 % of patients diagnosed with a primary tumour will relapse, having other tumours spread in their body[1,2]. Metastasis accounts for 90 % of cancer related deaths and due to the complicated nature of cancer, a panoply of different inherent factors have been defined as the hallmarks of metastasis: motility and invasion, ability to modulate the secondary site or local microenvironments, plasticity, and ability to colonise secondary tissues[3]. In the context of personalised medicine, the analysis of single cells is key in order to understand the origin and evolution of cancer to provide accurate prognosis.[4] Microfluidics and microdroplets have been increasingly used for the handling and understanding of the behaviour of single cells, as they offer the perfect isolated environment. Herein, we developed a protocol for fast phenotyping of different cancer cells types, based on surface-enhanced Raman scattering (SERS) spectroscopy and microdroplets. In this optofluic based platform, gold nanostars were used as SERS tags to identify the phenotypic characteristics of the cells that were previously encapsulated in microdroplets to allow single-cell analysis. The signal corresponding to the SERS tags paired to the expression of EpCAM, even at low expression levels, was identified for two different cancer cells lines (SK-BR-3 and MDA-MB-435). This integrated optofluidic platform paves the way towards the multiplex and automated characterisation of cell populations in cancer patients.

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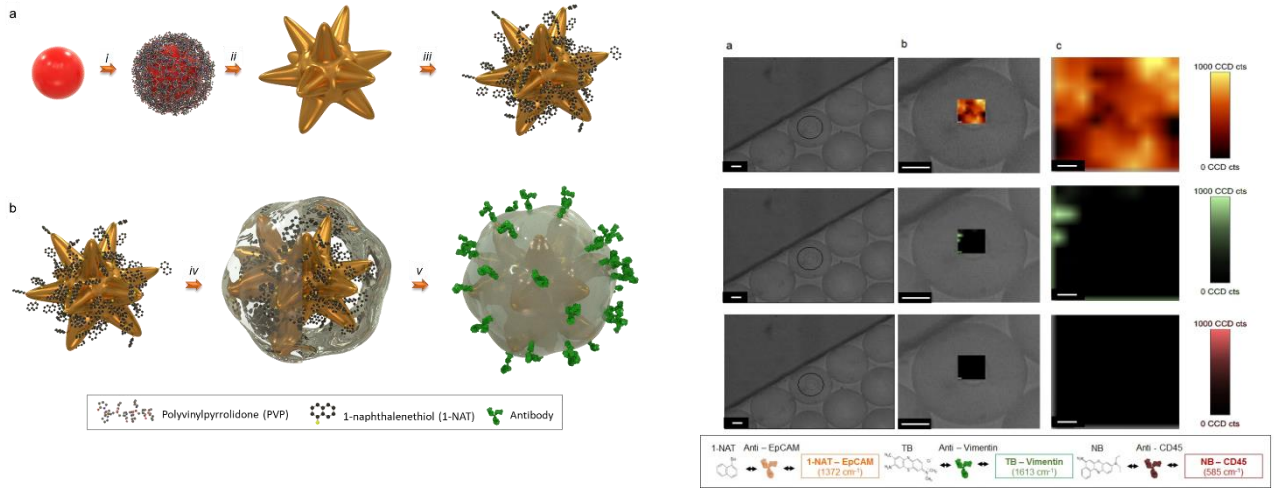

Figure 1: Left: Scheme depicting the synthesis of SERS tags; right: single cancer cells in droplets and corresponding SERS mapping.