Microfluidic induced supercrystals for on-chip ultrasensitive SERS detection

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Microfluidic platforms allows generating a highly-ordered assembly of uniform gold nanoparticles inside their microchannels through the pervaporation of the solvent (Figure 1A-B).1 Furthermore, the microfluidic approach enables the fabrication of uniform assemblies of any dimension or morphology. The resulting plasmonic devices could be used for the detection of analytes, even without affinity for gold nanoparticles.

Surface-enhanced Raman spectroscopy, SERS, is an advanced analytical technique that can be used for the ultrasensitive detection of analytes since it offers orders of magnitude increases in Raman signals. It occurs at the surface of a plasmon surface mainly due to the presence of strong electromagnetic fields generated after the plasmon excitation. Moreover, this effect could be more intense in the case of hierarchical nanoparticles assemblies due to an antenna effect as demonstrated by recent simulations.2

While the plasmonic substrates made by drop-casting show poor uniformity that limits their potential plasmonic applications, the microfluidic approach gives rise to platforms with highly uniform and intense SERS activity (being both key parameter to achieve quantitative analysis and low detection limits (LOD). Herein we will show the fabrication and characterization of plasmonic platforms fabricated using Au octahedra synthesized through a wet chemical method. Besides, the sensing capabilities of the platforms will be analyzed by investigating the SERS efficiency using different Raman active analytes. For instance, experiment performed with Malachite Green showed a great LOD, lower than 100fM, which is several orders of magnitude lower than those found in the literature.

Figure 1. (A) Schematic illustration of the evaporation-based microfluidic cell used for controlled assembly of Au nanoparticles. (B) SEM images of the hierarchical nanoparticles assembly (C) SERS mapping of the channel in the presence of 100 fM of Malachite Green.

References
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