SERS improvement by a gold reflective underlayer and localised detection of thiophenol by SFG for gold nanotriangles

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Firstly, we report on an improvement way of the SERS signal of Au nanotriangles for a highly sensitive detection of chemical molecules. This improvement is obtained by a simple addition of a gold reflective layer under Au nanotriangles. Using the same Au triangular nanoprisms obtained by nanosphere lithography (NSL) (see figure 1(a)), we studied experimentally the thickness effect of this gold underlayer on the SERS intensity of the gold nanotriangles. We demonstrated that this SERS intensity increased with the thickness of the gold reflective underlayer (see figure 1(b)), and this is due to the increment of the Au underlayer reflectivity. Indeed, enhancement factors of 10⁴ were found for the most important thickness of the gold underlayer¹. Secondly, with these same structures with a gold underlayer thickness of 30 nm, we detected two vibrational modes of thiophenol molecules localised on the lateral sides (walls) of the nanotriangles by using the Sum-Frequency Generation (SFG) spectroscopy (see figure 1(c)). Raman shifts of these two modes are 3050 and 3071 cm⁻¹, whereas they are usually very difficult to distinguish by SERS and other vibrational optical probes. In the ssp-configuration of our SFG setup, these vibrational modes have been detected thanks to the excitation of a transversal plasmon mode by the incident visible laser beam².

![Figure 1. (a) SEM image of gold nanotriangles on a gold film obtained by NSL (scale bar = 500 nm), (b) SERS spectra of thiophenol molecules obtained with gold nanotriangles for 3 different thicknesses of the underlayer (black = 30 nm, red = 50 nm and blue = 100 nm), and (c) SFG spectrum of thiophenol molecules obtained with the gold nanotriangles on a gold film of a 30 nm-thickness in ssp-polarisation configuration of our SFG setup for an incident visible beam wavelength of 532 nm.](image)

References