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Annealed Gold Nanoparticles on Nanostructured Aluminum Substrates as a Low-cost SERS Platform

A simple and robust method for the development of high amplification SERS platforms is presented based on the decoration of Au nanoparticles into high-density Al nanoconcavities arrays. The nanostructured Al templates are obtained with an initial two-step electrochemical anodization of the Al substrate and the subsequent removal of the formed alumina [1]. Phosphoric and oxalic acid are the electrolytes used for this anodization [2], obtaining nanoconcavities with different size and distribution [3]. The gold nanoparticles are formed by the sputtering of Au and a subsequent thermal annealing treatment (Fig. 1A). The gold deposition time and the temperature and duration of the thermal annealing are determining parameters of the shape, size and arrangement of the gold nanoparticles formed on the Al templates and therefore of the efficiency of the resultant platforms for the enhancement of the Raman signal and its application for SERS detection [4]. An intensive evaluation of these nanostructured Al substrates as SERS platforms is presented for a range of sputtering and thermal annealing parameters and for phosphoric and oxalic acid nanoconcavities distributions using 4-mercaptopyridine (4-MPY) as probe molecule (Fig. 1B). Enhancement Factors of the order of ~10^7 for only 10^{-7} M 4-MPY with both phosphoric and oxalic based platforms demonstrates the interesting potential for SERS detection of the presented platforms.

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Figure

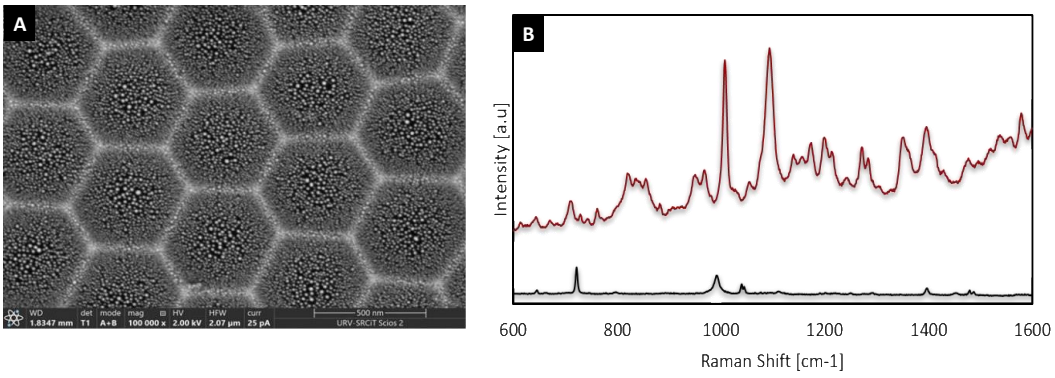

Figure 1: A) FESEM image of the gold nanoparticles on a highly uniform Al nanoconcavities platform. B) Enhancement of the Raman signal of a sample after sputtering and thermal annealing.