Surface Enhanced Raman Spectroscopic Studies using Galvanic Nano-buds

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Raman spectroscopy has attracted considerable attention in analytical measurements but lacks the sensitivity due to low scattering cross section. However, surface enhanced Raman spectroscopy (SERS) has brought both specificity and sensitivity on the same platform. The specificity in SERS technique is largely owing to the unique vibrational frequency of the molecules giving rise to finger print like spectra. Sensitivity, however, is tailored from electric field enhancement in plasmonic nanostructure and fabrication of nanostructure for a specific wavelength. Control of size, shape of suitable plasmonic material and there by excitation of localized surface plasmon resonance of a metal nanoparticle or nanostructured surface is essential in understanding the fundamental process of SERS. Optical property of the surrounding medium has profound effect on the plasmonic response of the metal nanoparticles. Such type of interaction in SERS substrates, associated to plasmon-substrate interaction, brings out simple yet effective method to fabricate SERS substrate.

There is a definite requirement of advance surface plasmon simulation tools to design the substrate with nanoparticle or determining the shape of nanostructure with respect to a specific wavelength of excitation to obtain maximum sensitivity. Fabrication of such precise structures on substrates can be achieved by e-beam lithography but the method is inadequate to produce large area substrates. In addition, SERS requires unconventional substrates, substrates without the requirement of simulation yet possessing tunability towards a specific wavelength, large area fabrication process and with a high shelf-life. This next generation SERS substrate called Ag-Nanobuds, caters the need of the users as per the requirement and for a specific wavelength (Fig1).

The versatility of the application does not end with fabrication of a sensitive substrate. The embodiment of an adaptive SERS substrate or method and an existing technique further improves the usability of the whole system. In an attempt to accomplish the same, SERS substrate has been integrated with microfluidics in order to increase the potential application and versatility of both the methods.

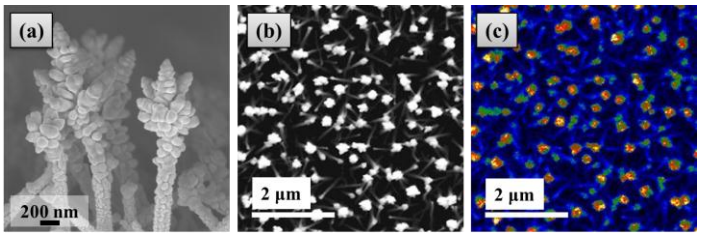

Fig1. (a) Cross section and (b) top view SEM images of the Ag nano-bud substrate. (c) Cathodoluminescence map of the enhanced field/hotspots of the substrate in the green (500 nm – 575 nm) spectral range.