Nano-pillar structured SERS-active substrate based on nano-imprint technology

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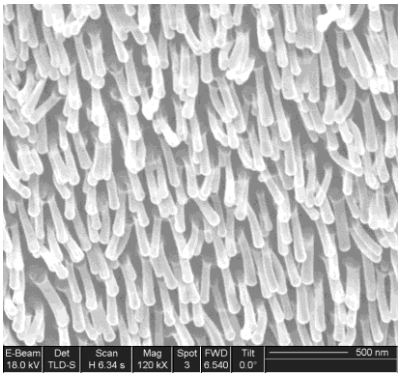
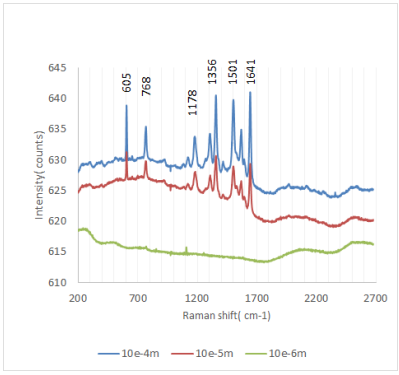
Background Metalic nanostructures/ nanoparticles have been crucial important to Surface enhance Raman scattering (SERS) method in detecting, identifying and quantifying bio-sensing. Fabrication approaches can be simply classified by Top-down techniques and Bottom-up techniques. Among numbers of developed means, in this work we are going to reveal a method which is tunable, easy to scale up and possible of mass-production at low-cost via nanoimprint technology. Merits mentioned above fitly meet the needs of bio-sensing development. Nano-porous Anodic Alumina Oxidation (AAO) substrates are utilized as mold in this method, parameters of which are possible to be designed within a wide range (30nm~ 400nm). By using nano-imprint technology, nano-pillar structure can be easily transferred onto Cyclo Olefin Polymer (COP) resin. Au nano-layer was sputtered subsequently.

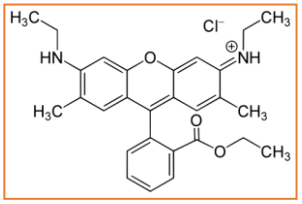
Experiments In this work, we emplyoed Raman dye Rhodamine 6G (R6G) as target to assess our Au-capped nano-pillar structure. AAO mold was fabricated by a two-step anodization which is operated at 80v in oxalic acid solution. Wet etching was performed in phosphoric acid solution subsequently. After nano-imprinting and Au-sputtering (50nm) procedure, R6G aqueous solution with 3 different concentration (10E-4 M, 10E-5 M, 10E-6 M) was dropped onto the roughly gold surface. Chips were washed and nitrogen dried after 30min adsorption. Processed substrates were observed and measured through SEM and Raman microscope RAMAN-11. SERS bands of R6G were confirmed in spectra. Signal intensities were also manifested concentration dependency. Experimental results indicated that, substrate with relative lengthening nano-pillar could stimulate more legible raman signal of R6G. Tuning is possible by varing AAO mold parameters and the thickness of Au thin layer, upon which increase in the number of hot-spots may lead to possiblity of quantification. Furthermore, bio-specimen detection is under discussion.



SEM image of Au- capped nano-pillar structure



SERS signal of R6G adsorption carried with 3 different concentration



Molecular formula of R6G