



Gold Nanoparticle Preconcentration for Surface Enhanced Raman Scattering in a Microfluidic Chip



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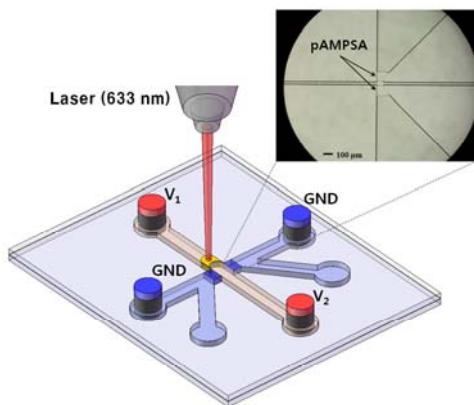
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INTRODUCTION

- Surface-enhanced Raman Scattering (SERS)
- SERS on a Chip using preconcentrated gold nanoparticles
- Preconcentration Method
 - : Electrokinetic trapping
 - Ion-depletion
 - Extract cations through the charge selective polymer, pAMPSPA (poly-2-acrylamido-2-methyl-1-propanesulfonic acid)
- Samples (SERS analytes)
 - 4-aminobenzoic acid (4-ABA)
 - Pyridine
 - 4-mercaptobenzoic acid (4-MBA)
 - Neurotransmitter (Histamine)

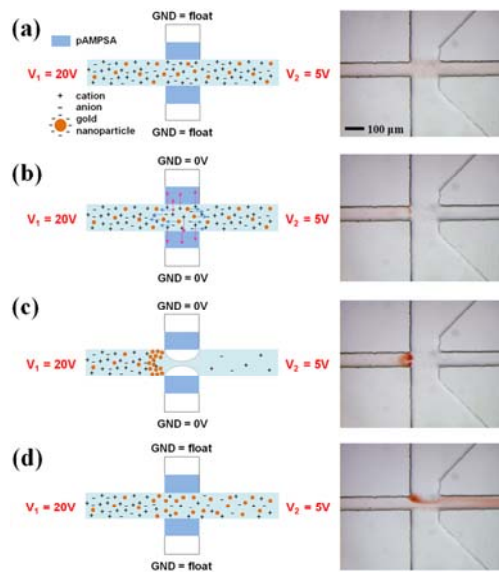
METHODOLOGY

A. SERS on a Chip



- Glass to glass microfluidic chip
 - Width : 70 μm , Height : 30 μm
- pAMPSPA
 - Width : 90 μm , Depth : 30 μm
- Electrode : Platinum
- Laser : He-Ne 633 nm (5mW)
- Customized micro-Raman spectroscopic system
- Power
 - 2 channel DC
 - 20V (V_1), 5V (V_2)
- Gold nanoparticle
 - 20 nm (dia.) in 10 mM PB
 - PB (Phosphate Buffer)

B. Working principle : gold nanoparticle preconcentration

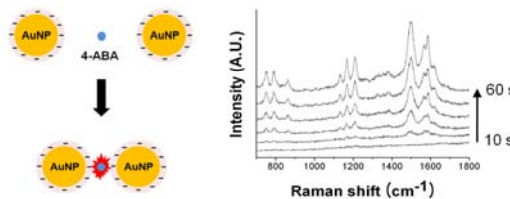


C. Experimental Results

: SERS signals were obtained every 10 sec

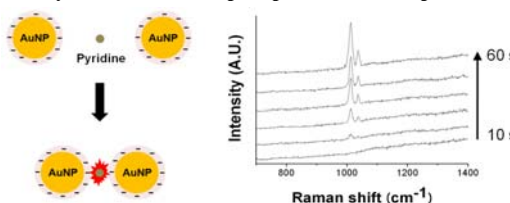
(1) 4-aminobenzoic acid (4-ABA)

- Sample : Mixture (20 μL) of 0.1% AuNP and 10 μM 4-ABA in 10 mM phosphate buffer at pH 4.0



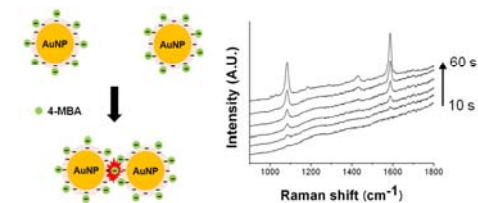
(2) Pyridine

- Sample : Mixture (20 μL) of 0.1% AuNP and 10 μM Pyridine in 10 mM phosphate buffer at pH 8.0



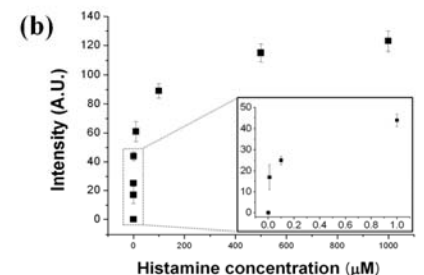
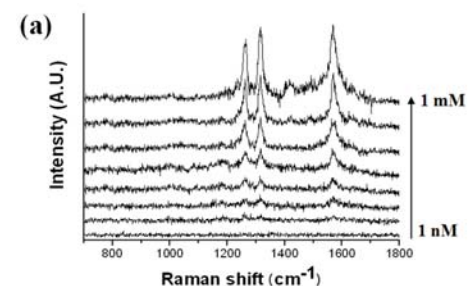
(3) 4-mercaptobenzoic acid (4-MBA)

- Sample : 0.1% 4-MBA-modified AuNPs (20 μL) in 10 mM phosphate buffer at pH 7.0



(4) Histamine

- Sample : Mixture (20 μL) of 0.1% AuNP and Histamine in 10 mM phosphate buffer at pH 11.5
- SERS signals were obtained at 60 sec



(a) SERS spectra for a variety of concentrations (1 nM, 10 nM, 100 nM, 1 μM, 10 μM, 100 μM, 500 μM and 1 mM) of histamine which was mixed with AuNPs in 10 mM phosphate buffer at pH 11.5.

(b) The intensity of a characteristic peak of histamine versus its concentration.

DISCUSSION

- The reversible preconcentration and redispersion of AuNPs were realized by electrokinetic trapping in the microchannel.
- The preconcentrated gold nanoparticles can be used for SERS analysis.
- This unprecedented dynamic SERS substrate needed neither well-defined nanostructures nor irreversible treatments like silvering to obtain strong signals.