OMICS Group Conferences
Accelerating Scientific Discovery

2nd International Conference on
Nanotek and Expo

December 3-5, 2012 DoubleTree by Hilton Philadelphia Center City, USA

Thorough tuning the aspect ratio of noble metal nanorods using response surface methodology

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Surface-enhanced raman scattering (SERS) has introduced a new era of conventional Raman spectroscopy through overcoming inherent feeble molecular Raman signal problems by remarkable amplification of signals with many orders of magnitude. Because of highly dependence of the both electromagnetic (EM) and chemical (CHEM) enhancement mechanism to the nature of substrate, demands for optical nanoprobes with much highly order of sensitivity, selectivity, and stability have been implemented research groups to introduce a new generation of substrates with reproducible geometries and much higher enhancement factor.

Gold nanorods (GNRs) are becoming increasingly important as a result of having fundamentally attributes that replace them as a promising candidate for SERS. These unique properties are accounted by the oscillations of their conduction free electrons, perpendicular and parallel to the rod length axis, in resonance with certain frequencies of incident light, which results in two surface plasmon-resonance (SPR) modes are called the transverse and longitudinal plasmon modes, respectively. By finely controlling the aspect ratio (AR) of nanorods, which is defined as the length of the major axis divided by the width of the minor axis, the longitudinal surface plasmon (LSP) is tunable throughout the visible and near-infrared region of the spectrum. This results in vastly increasing of signals by optimizing the contribution of the electromagnetic enhancement mechanism to the overall enhancement that can replace gold nanorods to an unrivaled substrate for SERS purposes.

We herein report our recent studies on controlling the aspect ratio of noble metallic NRs by thorough tuning the LSP of seed mediated synthesized short gold nanorods using response surface methodology (RSM). The effect of four parameters, including ratio of reducing agent (l-ascorbic acid) to Au^{+3} ions, concentrations of silver nitrate, CTAB, and CTAB- capped gold seeds has been investigated on the aspect ratio of gold nanorods. The statistical method of response surface methodology (RSM) that employs quantitative data of appropriate experiments for developing and simultaneously solving multivariate equations, was undertaken to assess the interactions between parameters and their impacts on the response. The obtained results enabled us for high yield synthesis of gold nanorods with desire aspect ratios ranging from 1(spherical particle) to 4.9 and corresponding tunable surface Plasmon absorption band extended to 880 nm.

Biography

Mr. Hossein Robatjazi obtained his B.S. degree in applied Chemistry from Isfahan University of Technology (2009), and as completed his M.Sc in Analytical Chemistry at the age of 26 years from Sharif University of Technology. He has published 3 papers in reputed journals and some papers are in press. Now he is serving as co-worker in Nano-Bio Interactions Laboratory, National Cell Bank, Pasteur Institute of Iran. His research focused on the synthesis, characterization of different morphology of plasmonic nanoparticles and investigating their potential applications in nano-bioscience. Mr. Robatjazi received a Ph.D position from Rice University, School of Chemistry started by the spring 2013.

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