Biosensing applications of silver nanorods array

Shashank K. Gahlaut, PhD, Indian Institute of Technology Delhi, India

J.P. Singh, PhD, Indian Institute of Technology Delhi, India

Abstract (300 word limit)

Silver nanostructures have been always a material of attraction due to its outstanding electrical and optical features. Here, silver nanorods (AgNRs) array fabricated on glass substrates by electron beam dynamic angle deposition, has been employed in biosensing applications. The average length and diameter of the nanorods were determined to be 900 nm and 100 nm respectively by electron microscopy. The colorimetric and water wetting properties of as-fabricated AgNRs arrays were found to be highly sensitive towards the sulfurization. In the presence of H_2S gas, the as-fabricated whitish AgNRs array turns black (due to formation of black Ag_2S). In addition, it also changes its water wetting property from hydrophobic (water contact angle CA=128°) to hydrophilic (CA=65°). The coproduct of the reaction; OH- ions on the AgNRs surface may found to attribute to enhance the wettability. The dual mode rapid and selective detection of H_2S gas was demonstrated by using a house-made android based mobile app "Colorimetric Detector". The performance of the sensor was investigated by its sensing ability of 5 ppm of gas with exposure time of only 30 seconds.

This novel method of detection also employed to detect the H_2S gas from bacterial cells in order to determine their viability and antibiotic resistance. The method was found user-friendly, cost effective and time saving as compare to conventional techniques.

The used substrates (sulfurized silver) in abovementioned applications were confirmed as the Ag-Ag_2S, which were further utilized in various potential applications e.g. photocatalytic dye degradation under visible light irradiation, photoelectrochemical reaction in the study of hydrogen production, SERS based chemical detection and antimicrobial activity. In the view of highly efficient plasmonic property of uniformly arranged noble metal nanoparticles, AgNRs array were found to the potential SERS substrates with Raman signal enhancement factor of 10^8. A portable early stage Dengue diagnostic platform was developed and successfully distinguished the clinical blood samples as Dengue positive, negative and healthy individuals with the help of a statistical data analyzing tool (Principal Component Analyzer; PCA).

Image

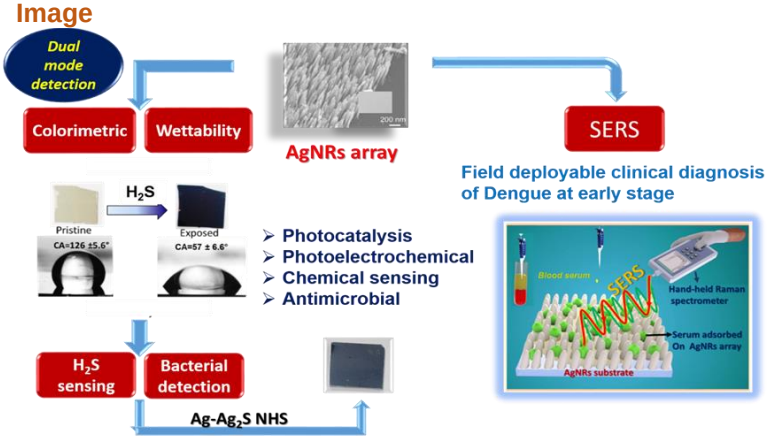


Fig. Biomedical applications of silver nanorods array substrate in gas and pathogen sensing

Recent Publications (minimum 5)

1. S.K. Gahlaut, K. Yadav, C. Sharan and J.P. Singh 2017, Quick and Selective Dual Mode Detection of H2S Gas by Mobile App Employing Silver Nanorods Array, Analytical Chemistry 89, 13582.
2. S.K. Gahlaut, N. Kalyani, C. Sharan, P. Mishra and J.P. Singh 2019, Smartphone based dual mode in situ detection of viability of bacteria using Ag nanorods array" Biosensors and Bioelectronics 126, 478.
3. Shashank K. Gahlaut, D. Savargaonkar, C. Sharan, S. Yadav, P. Mishra, J. P. Singh 2020, SERS Platform for Dengue Diagnosis from Clinical Samples Employing a Hand-Held Raman Spectrometer" Analytical Chemistry 92, 3, 2527-2534.
4. S.K. Gahlaut, P. Devi, J.P. Singh 2020, Self-sustainable and Recyclable Ag Nanorods for Developing Ag-Ag2S Nano Heterostructures using Sewage Gas, Applied Surface Science, 528, 147037.
5. S. Yadav, S. Senapati, D. Desai, S.K. Gahlaut, S. Kulkarni, J. P. Singh 2021, Portable and sensitive Ag nanorods based SERS platform forrapid HIV-1detection and tropism determination" Colloids and Surfaces B: Biointerfaces 198, 111477.



Biography (150 word limit)

Shashank K. Gahlaut has his expertise in fabrication of nanomaterials and their applications in biomedical science. He seeks to develop the point-of-care solutions in medical diagnosis using nanotechnology. He received his B.Sc. (Hons) in 2012 and M.Sc. degree in 2014 in Physics from Department of Physics and Astrophysics, University of Delhi, India respectively. He earned Ph.D. degree in 2015 from Department of Physics, Indian Institute of Technology Delhi. He has been an INSPIRE fellow in 2015-2020. His research interest includes gas sensors, biosensors, glancing angle deposition, chemical vapor deposition, surface enhanced Raman spectroscopy and their biomedical, energy and environmental applications.

Email: skgahlaut.iitd@gmail.com

Notes/Comments: