SERS using Self-Assembled Nano Structures of Different Geometry. Special Case of Wires, Spheres and Triangles

A. Tamulevičienė[1], J. Jokšaitė[2], N. Khinevich[1], M. Juodėnas[1], T. Tamulevičius[1], S. Tamulevičius[1]
[1]Institute of Materials Science, Kaunas University of Technology, K. Barsausko 59, Kaunas LT-51423, Lithuania
[2]Physics department, Kaunas University of Technology, Studentų Str. 50, LT-51368, Kaunas, Lithuania

Silver and gold nanostructures are the main players in the field of optical sensors where surface enhanced Raman scattering effect is employed. By changing the plasmonic metal, nanoparticle shape, and size it is possible to tune the localized surface plasmon resonance position and therefore adjust the sensitivity for certain excitation laser wavelength. The current research shows how we can create SERS active layers for particular wavelength by adjusting the shape and size of nanoparticles.

Silver nanowires were synthesized using polyol synthesis as described in [1]. Spherical silver [2] and gold [3] nanoparticles as well as triangular gold nanoparticles [4] were synthesized using seed mediated growth methods. Optical properties in a range of 190-1100 nm were probed using Avantes spectrometer. Nanoparticle linear dimensions and its dispersion were analyzed using SEM Quanta 200 FEG (FEI). Random monolayer of nanoparticles was deposited on the surface of porous silicon from the liquid-liquid interface. Additionally, the patterns of nanoparticles were deposited using capillary assisted particle assembly on PDMS templates. SERS measurements of 2-naphthalene thiol were performed with 532 nm wavelength excitation (in Via spectrometer).

We have shown the efficient assembly of nanoparticles on the liquid-liquid interface and transfer of those layers onto solid support (porous silicon, PDMS).

We conclude that the analysis of SERS signal on the created structures using 2NT as analyte material was investigated and detection of concentrations down to 10-8M was demonstrated.

References

[1] Zhang, J., Wang, Q. Carbamide promoted polyol synthesis and transmittance properties of silver nanocubes. Inorganic Chemistry Frontiers, 2016, 3(4), p. 547-555.
[2] Neus G. Bastus, Florind Merkoci¸ Jordi Piella, and Victor Puntes, Synthesis of Highly Monodisperse Citrate-Stabilized Silver Nanoparticles of up to 200 nm: Kinetic Control and Catalytic Properties, Chem. Mater. 2014, 26, 2836−2846
[3] Neus G. Bastus, Joan Comenge, and Víctor Puntes, Kinetically Controlled Seeded Growth Synthesis of Citrate-Stabilized Gold Nanoparticles of up to 200 nm: Size Focusing versus Ostwald Ripening, Langmuir 2011, 27, 11098–11105
[4] Leonardo Scarabelli and Luis M. Liz-Marzán, An Extended Protocol for the Synthesis of Monodisperse Gold Nanotriangles, ACS Nano 2021, 15, 18600−18607.