

## **Surface enhanced spectroscopy for application in nanotechnology**

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Surface enhanced spectroscopy (SES) is a sensitive analytical tool for identification, characterization and obtaining new physical and chemical data about nanostructured systems. This method includes: SEIRA (surface enhanced infrared absorption), SERS (surface enhanced Raman scattering), SEF (surface enhanced fluorescence) spectroscopy. Any spectroscopic technique, in which for increase of output optical signal from molecule, a substrate of metal or non-metal type (e.g. graphene) is used, could be named as SES. In traditional SES spectroscopy the researchers apply rough or periodic metallic substrates as well metallic particles. However, non-metallic substrates, as carbon nanostructures, dielectric and semiconductor structures, could be a good enhancers also. Effect of enhancement of optical transitions of molecules near metallic surface is typically explained by CM (chemical mechanism) and EM (electromagnetic mechanism). CM is due to charge transfer between the probed molecule and the substrate. The nature of EM mechanism is connected with increase of the local electric field caused by plasmon resonance. These two mechanisms always contribute simultaneously to the overall enhancement, while the EM provides the main enhancement. The method could be applied for study metallic clusters, molecules, graphene-type nanostructures, quantum dots, clusters from dielectric materials, etc. Here we present data on study of different cells and biological molecules (DNA, poly-A, DNA bases, proteins, amino acids, lipids) adsorbed on the surface of metallic and non-metallic surfaces as well study of carbon nanotubes and graphene-type structures and their application as support for biological molecules. Discussion of mechanism of enhancement for different graphite- type substrates are presented here.

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