Nanoplasmonics and surface enhanced spectroscopy

Graphene enhanced Raman scattering effect from biological molecules

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Present-day requirements to the sensing of biological agents implies detection of minute amount of material down to the separate molecules. It is known that spectral signals from these molecules can be enhanced in the vicinity of nanostructured noble metal films or noble metal nanoparticles. Surface enhanced Raman scattering (SERS) and surface enhanced infrared absorption (SEIRA) can be taken as a routine examples of such approaches. However separation of electromagnetic and chemical effects responsible for the overall Raman enhancement factor is still a matter of scientific discussions.

Recently it was shown that using of graphene as a SERS substrate can help in separation of effects responsible for the chemical enhancement of Raman signal. Since surface plasmons in graphene can be excited only in the deep infrared THz spectral range, enhanced Raman scattering in the visible spectral range can be associated only with chemical mechanisms.

Here we represent our SERS results obtained from biologically important analytes deposited on the graphene surface. Particularly droplets of water solutions of glycine, adenine and DNA were dried on the graphene surface and after that excited by 488 nm and 514 nm lines of Ar laser. For comparison these materials deposited on the pyrolytic carbon and graphene oxide were also tested.

Intensity of Raman scattering was different for different materials. We obtained essentially 2-10 times enhanced Raman signal only for the adenine. We associate this enhancement with charge transfer effects appearing in case of close contact between the tested molecules and graphene surface. Polarizability of adenine molecule is changed after resonance electron transfer from graphene.

It results in enhanced Raman response from this material. The features of this so-called chemical mechanism of Raman enhancement are discussed also relatively to the other constituents of deoxyribonucleic acid.

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