SEMINAIRE ISMO

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Towards a comprehensive model of Surface Enhanced Raman Scattering (SERS)

Strong local electromagnetic field of the incident laser frequencies are achieved by surface plasmon resonances in noble metal particles and in well fabricated plasmonic nanostructures. Raman scattering of adsorbed molecules is enhanced by both the local field enhancement at the incoming laser radiation and the emitted Stokes shifted radiation. Strong so-called electromagnetic (EM) enhancements are observed at EM "hot spots" within the narrow gap between two silver spheres up to about 10^6 - 10^7 . According to quantum plasmonics the value decreases when the gap becomes smaller than 4 Å. EM-SERS has many applications in biomedical analysis.

The EM model the describes the metal structures with a dielectric constant and a sharp boundary, all aspects of the real atomic structure and of electrons "spilling out" and the details of the Raman scattering process are neglected.
Due to the atomic structure of the real "plasmonic particles, there are smooth facets but also metal atoms with a coordination number equal or less than 7, comprising "SERS-active sites" with a subgroup of "chemical active sites". The enhancement of the Raman signal is given by the product of EM enhancement and enhancement by transient electron transfer(TET). In some cases, the extra enhancement at "SERS active sites" is higher than the EM enhancement. The enhancement at "SERS active sites" is quenched by oxygen exposure, which is well understood. As all SERS-applications are made in air, only the EM enhancement is relevant. For adsorbates on smooth terraces no "first layer effect" is observed, but only an adsorbate induced background of electron hole pairs. This may be explained with concepts of femtosecond optics.

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