

4<sup>th</sup> International Conference on

## PHOTONICS &amp; LASER TECHNOLOGY

July 28-29, 2016 Berlin, Germany

**Aleksey Mickhailovich Polubotko**<sup>1</sup> A F Ioffe Physico-Technical Institute, Russia<sup>2</sup> State University of Information Technologies, Russia**Strong quadrupole light-molecule interaction and surface-enhanced optical processes**

Surface-Enhanced Optical Processes, SERS, SEHRS and SEIRA are of great interest for physics, chemistry and biology since they all allow increasing strongly the sensitivity of these spectroscopic methods and there is a fundamental physical mechanism, which causes the enhancement in these processes. It is so-called strong quadrupole light-molecule interaction, arising in surface electromagnetic fields, strongly varying in space near a rough metal surface. Just this interaction is responsible for the enhancement in SERS  $10^6$ , in SEIRA  $10^3 - 10^4$  and in SEHRS  $10^{12}$  and significantly higher. Moreover, this interaction is the base for implementation of Single Molecule Detection by SERS, when the enhancement can achieve the value  $10^{14} - 10^{15}$ . This interaction is responsible for appearance of forbidden lines in all these processes on molecules with sufficiently high symmetry. Indeed, these strong lines were observed in ethylene and diprotonated  $BiPyH_2^{2+}$  in SEIRA and in pyrazine and phenazine in SEHRS. They are the lines, caused by vibrations with the unit irreducible representation of a molecule symmetry group. Such strong lines are observed in SERS as well. However, they are caused by vibrations with the irreducible representations, which describe transformational properties of the dipole moment component, which is perpendicular to the metal surface. At present the theory of the above mentioned processes, based on this concept is created and explains the most of the observed phenomena, accompanying SERS, SEHRS and SEIRA.

**Biography**

Aleksey Mickhailovich Polubotko graduated from Physical Faculty of Leningrad State University in 1973. He completed his PhD in A F Ioffe Physico-Technical Institute Russian Academy of Sciences and defended the PhD thesis in Azerbaijan Institute of Physics in Baku in 1983. Currently, he works as a Physicist Theorist and a Senior Scientific Researcher of the sector of Semi-conductors and Dielectrics of the Department of Dielectrics and Semiconductors of A F Ioffe Physico-Technical Institute in Saint Petersburg. He has more than 120 scientific papers, preprints and abstracts published in reputed journals and reported in many scientific conferences.

alex.marina@pop.ioffe.rssi.ru