Title: **Light creation without pump: tuning plasmonic resonance for surface enhanced chemiluminescence.**

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Abstract:

Chemiphores are entities, which exhibit wide-band light emission without any external light source (pump) but just due to the chemical reaction resulting in chemiluminescence effect. Since the chemiphores usually have low quantum efficiency, the chemiluminescence is a weak optical effect. Surface plasmon resonance in metallic nanoparticles, however, can enhance the chemiluminescence of molecules due to the acceleration of radiative transitions. To enhance chemiphores-particles interaction, metal nanoparticles has to be placed at particular distance from the chemiphors. In addition, the shape and material of the particles has to be accurately chosen to tune their resonant absorption for the overlapping of plasmonic band with the emission band of chemiphors.

In our work, we studied the optical properties of silver nanoparticles of different shape and size to enhance the chemiluminescence effect. Numerical study was performed with COMSOL Multiphysics 5.3a while the experiment was carried out in microfluidic chip [1].

Figure 1. *Overlap between measured chemiluminescence intensity of the luminol solution and the extinction spectra of silver nanoparticle.*

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| We fabricated nanoparticles with laser ablation technique. In addition, we fabricated the particles using physical vacuum deposition technique on the transparent dielectric substrate. By comparing two fabrication techniques we found that the vacuum deposition technique allows for higher spectral tuning of surface plasmon excitation. According to our calculations, optimum overlapping with luminol emission is achieved for hemispherical silver nanoparticles with diameter of 18 and 73 nm on a quartz substrate as shown in Figure 1. Our calculations are confirmed by literature data on the extinction spectra for ensembles of silver nanoparticles on quartz substrates. To conclude, the arrangement of particles on the surface of transparent dielectric material makes it possible to control the distance between nanoparticles and chemiphoresan opens up the possibility of integrating substrates modified with nanoparticles into flowing microfluidic systems. |
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**References:**

[1] A. Karabchevsky, A. Mosayeebi, A. V. Kavokin, 'Tuning the chemiluminescence of a luminol flow using plasmonic nanoparticles', Light Sci Appl. 5, e16164 (2016).