Optical Properties of Silver-Silica Nanoshells

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Abstract - **In this paper we studied the scattering and absorption of light by nanoparticles and nanoshells of the different sizes. Comparison scattering spectra of the nanoparticles and nanoshells has been provided.**

Keywords - **Nanoparticle, Nanosheels, Scattering, Absorption.**

I. INTRODUCTION

Extensive theoretical and experimental studies of the interaction between an incident waves with metallic nanostructures, such as nanoparticles, nanodots, nanorings, nanocubes, nanoshells [1], have been achieved in physics and chemistry. Under illumination, these structures, due to local plasmon resonances, are known to exhibit a high enhancement of the electromagnetic field at their surfaces. This field strength depends on the size parameters of the particle and on two related quantities: the wavelength and the permittivity of the used materials (in the case of nanoshell, the core could be made of silica or just a vacuum). Due to this structural tunability of the plasmon resonances, such nanostructures can be of interest in a wide range of applications in biomedicine [2–3].

II. SCATTERING LIGHT BY NANOSHELLS

In this study, we focus on the design of nanoshells used in diagnostic (i.e. the scattering of these particles). The aim of the work was conduction of the comparison spectra absorption and scattering nanoparticles and nanoshells.

The total electromagnetic field property of a metallic nanoobject depends intrinsically on the geometry and on the optical properties of the involved materials. Nanoshells are composed of a core with radius *r*1 and of a metallic coating or shell of thickness ***e*** (see Fig. 1).

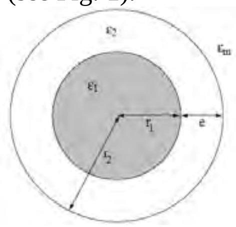

Fig. 1 Nanoshell: inner radius r_1 and shell thickness e

The core could be made of silica whereas the shell is made of silver. The permittivity of the core and the permittivity of the coating are denoted e_1 and e_2, respectively. The nanoparticles are embedded in a non-absorbing medium with permittivity e_m, corresponding to biological surrounding. From these parameters (size and permittivities), the absorption and scattering can be computed accurately by equations:

$$s_{abs} = \frac{8p\sqrt{e_2}r_2}{l}\Im(d), \tag{1}$$

$$s_{scat} = \frac{128p^5 e_2^2 r_2^6}{3l^4}|d|^2 \tag{2}$$

where: $d = r_2^3 \frac{e_{1,2} - e_m}{e_{1,2} + 2e_m}$, $\quad e_{1,2} = e_m \frac{1 + 2 f_{12} d_{12}}{1 - 2 f_{12} d_{12}}$,

$d_{12} = \frac{e_1 - e_2}{e_1 + 2e_2}$, $f_{12} = \frac{r_1^3}{r_2^3}$.

The spectrum characteristics nanoparticles and nanoshells are represented on fig. 1, 2.

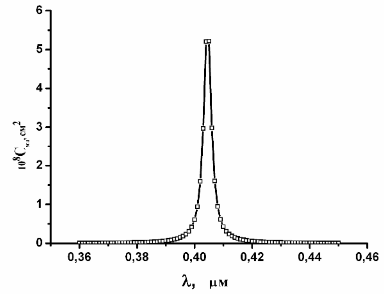

Fig. 2 Dependence scattering from wavelength for nanoparticles Ag (*r*=25 nm)

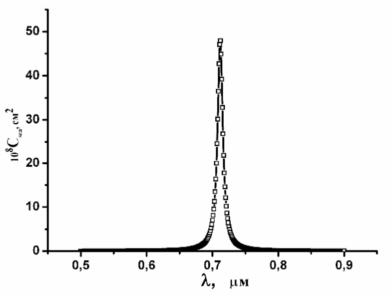

Fig. 3 Dependence scattering from wavelength for nanoshells (r_1=60 nm, r_2=70 nm)

III. CONCLUSION

Found that light scattering nanoshells order of magnitude higher than nanoparticles. Using nanoshells can shift peak absorption and scattering in the infrared spectral region.

REFERENCES

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