Modelling the Optical Properties of Triangular Ag Nanoprisms

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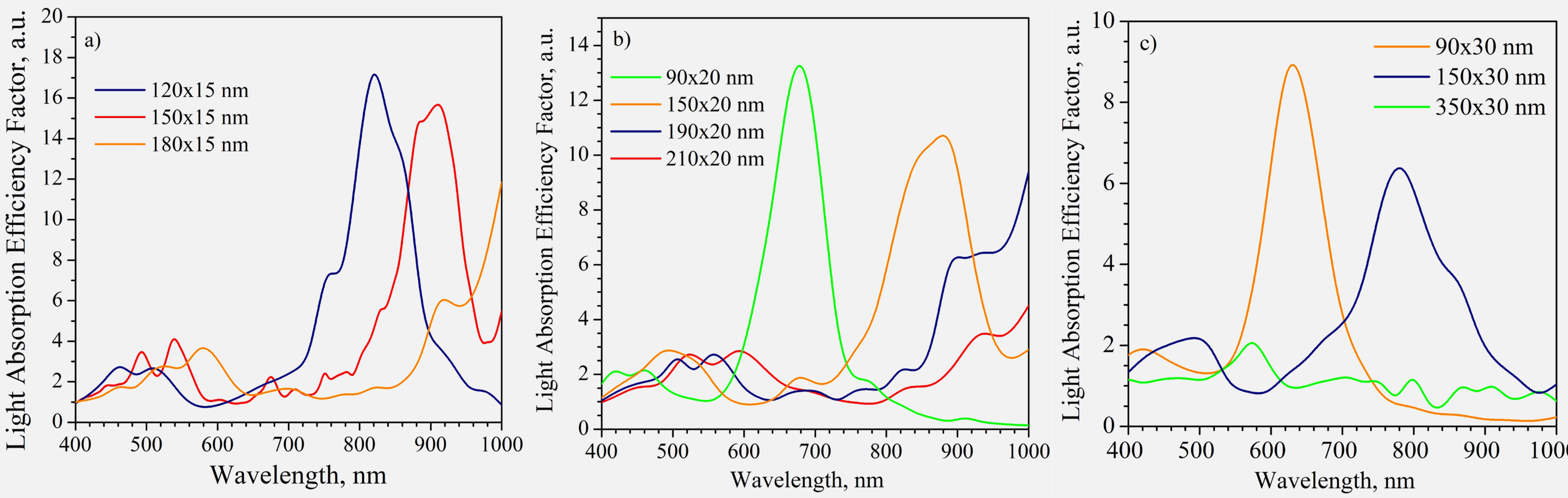
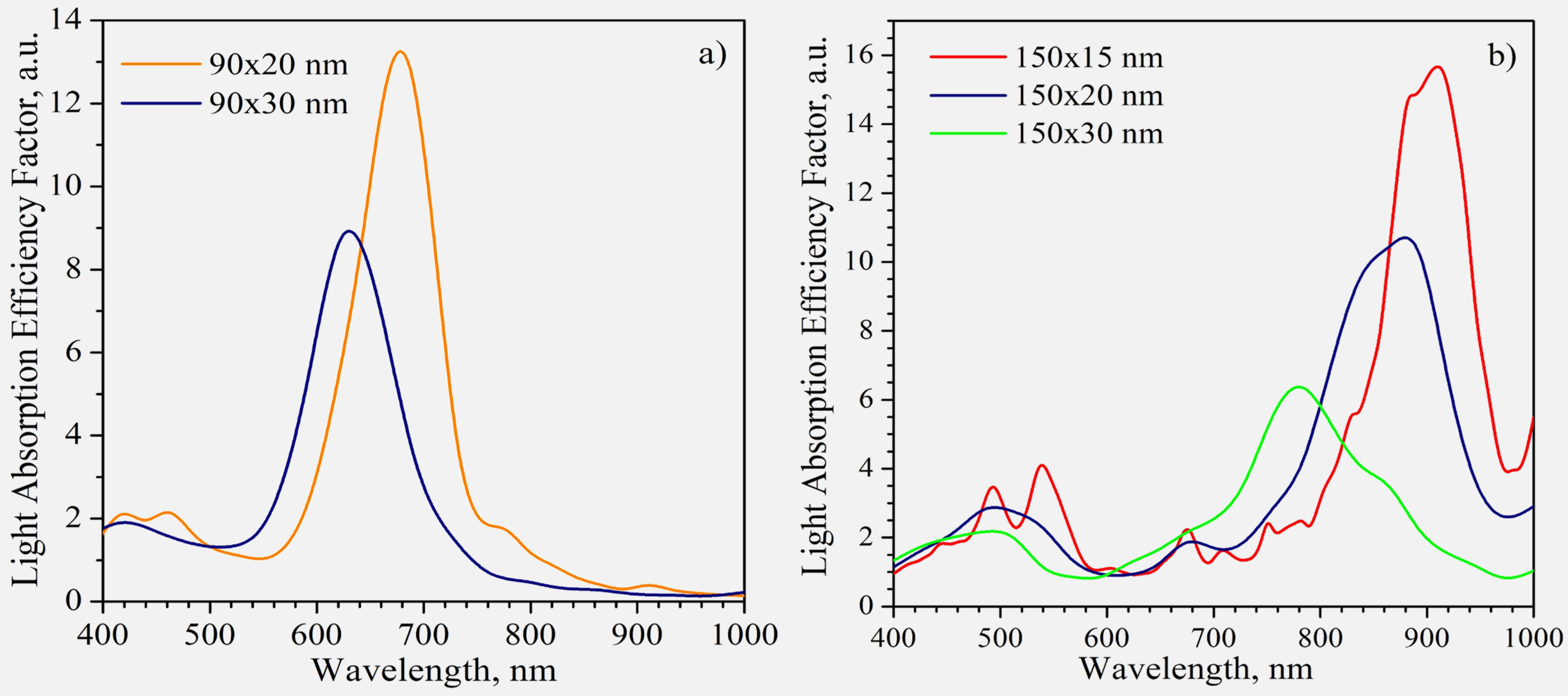
Among the number of plasmon nanostructures in recent years, triangular silver nanoprisms have been actively studied. Such structures are interesting due to their ability to exhibit plasmonic properties in the visible and NIR regions of the spectrum and can be used in biomedical and energy applications. The study of parameters that affect the optical properties of plasmon nanomaterials and allow controlling and adjusting the LSPR is a very important task. It is known that the critical parameters that affect the position of nanoparticles LSPR peak and are the material, size, shape, structure and parameters of surrounding medium. These parameters of nanomaterials are crucial for possibility of their practical application. Our interest was in the study of the influence of geometric parameters on the optical response of triangular Ag nanoprisms. Simulation of light absorption efficiency factor of nanotriangles in the visible and NIR range was performed using the DDA method.

Simulation of the optical properties of triangular silver nanoprisms



DDA simulation of light absorption efficiency factor for triangular silver nanoprisms in surrounding medium with a refractive index of 1.33 with a) thickness of 15 nm and edge lengths of 120, 150 and 180 nm; b) thickness of 20 nm and edge lengths of 90, 150, 190 and 210 nm; c) thickness of 30 nm and edge lengths of 90, 150 and 350 nm



DDA simulation of light absorption efficiency factor for triangular silver nanoprisms with a thicknesses of 20 and 30 nm and edge length of 90 nm (a) and thicknesses of 15, 20 and 30 nm and edge length of 150 nm (b)

Summarizing the presented results, we can say that increasing the edge lengths of triangular Ag nanoprisms at a constant thickness leads to a red-shift of the LSPR peaks and a decrease in their amplitude. On the other hand, an increase in the thickness of the triangular Ag nanoprisms at constant edge lengths leads to a blue-shift of the LSPR peaks.
Thus, by changing the size parameters of triangular silver nanoprisms, it is possible to obtain nanostructures with the desired optical properties: different positions of the LSPR on the spectral scale, amplitude, half-width, etc.

Conclusions

During the simulation, the edges lengths of the triangular nanoprisms were initially changed from 90 to 350 nm at a constant thickness. The obtained results show that the LSPR peaks had a redshift with increasing edge length of Ag nanoprisms. Moreover, the light absorption efficiency decreased with increasing edge length. In the following study, the edge lengths of the triangular Ag nanoprisms were maintained, while the thickness was changed from 15 to 30 nm. As a result, an increase in the thickness of nanoprisms leads to a blue-shift of the LSPR peaks and a decrease in the light absorption efficiency. Thus, changes in the geometric parameters of triangular Ag nanoprisms cause a change in their optical response. A clear understanding of how size affects the optical properties of triangular silver nanoprisms is important for their effective application.