Spectral characteristics of plasmonic copper monosulfide nanoparticles

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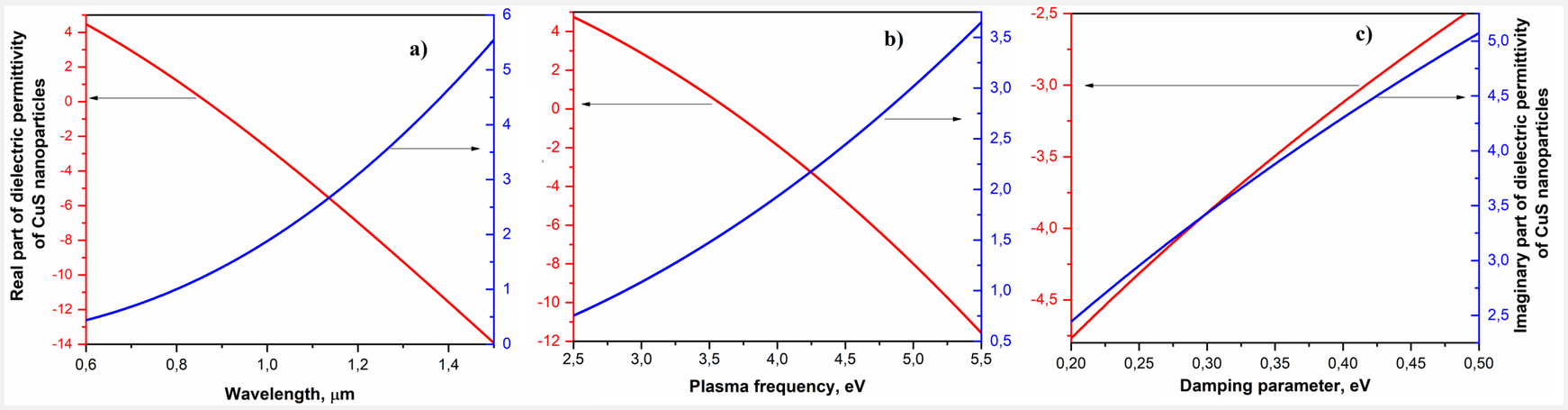
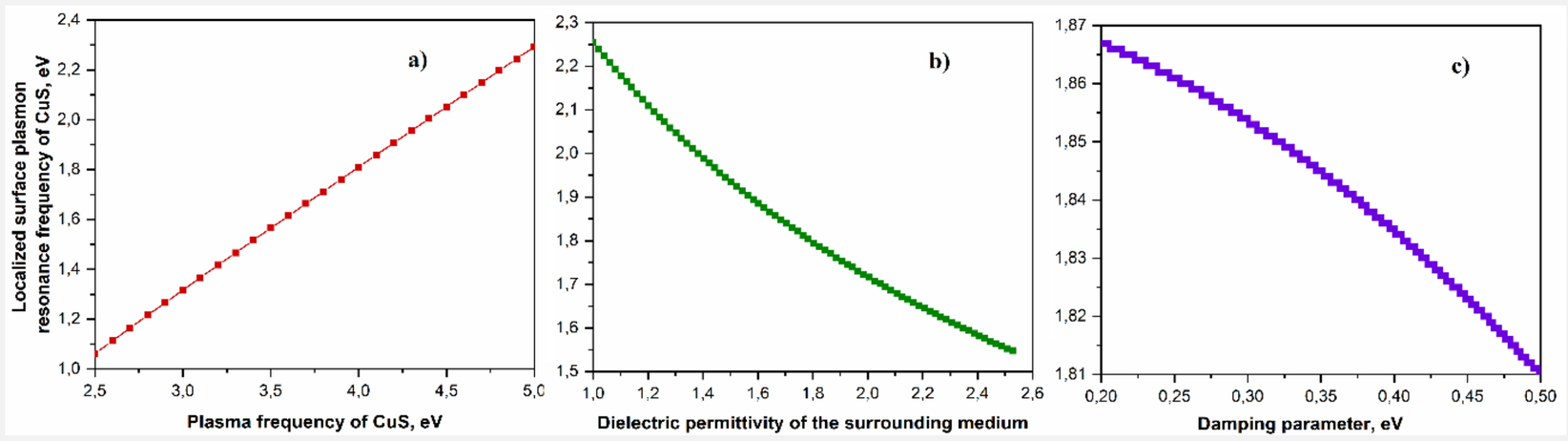
In this work, the influence of the structural parameters of CuS on its dielectric constant has been established. It is shown that the wavelength and plasma frequency have influence on the value of the complex dielectric constant of CuS nanoparticles. The spectral characteristics of CuS nanoparticles depending on their structural and geometric parameters were calculated.

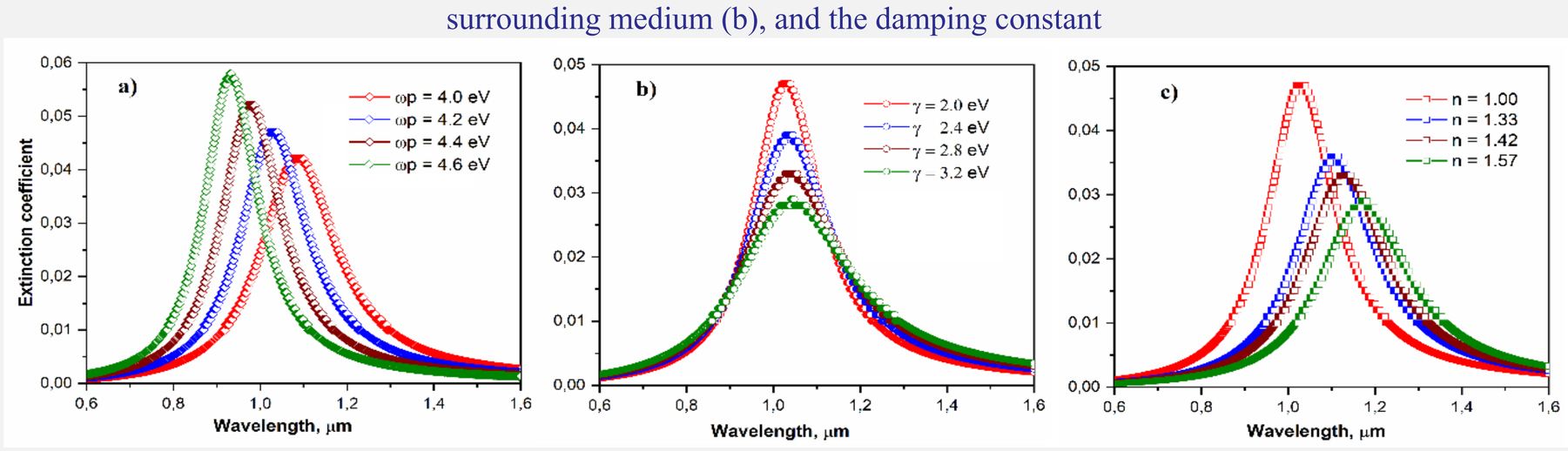
Results



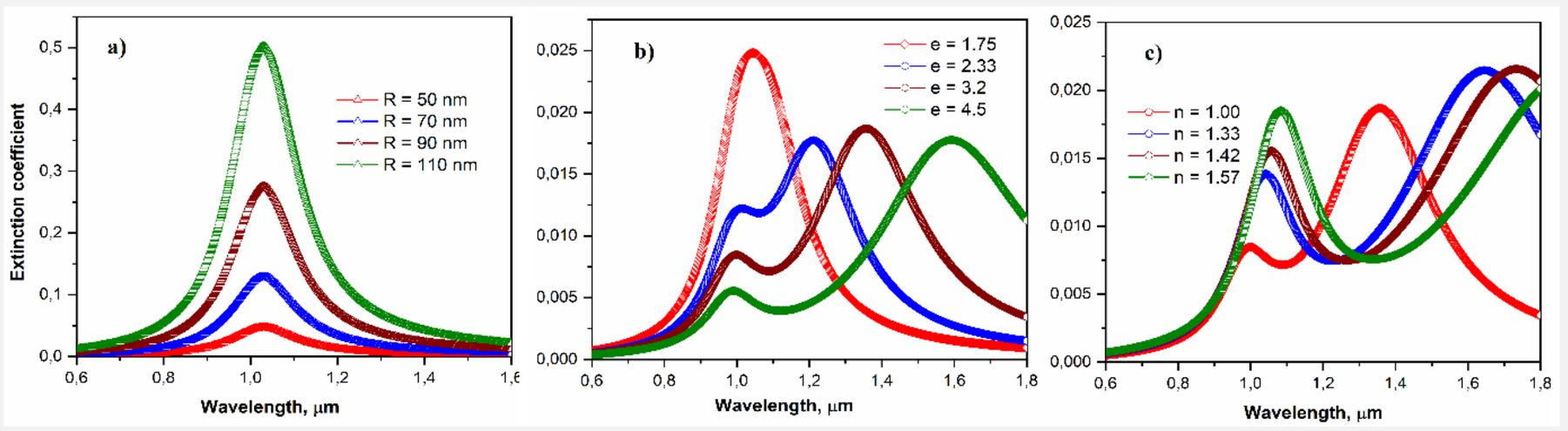
Dependence of the dielectric constant of CuS nanoparticles on the wavelength (a), on the plasma frequency (c), and on the damping constant (c)



Dependence of the localized surface plasmon resonance frequency of CuS nanoparticles on the plasma frequency (a), the dielectric constant of the surrounding medium (b), and the damping constant



Dependence of the extinction coefficient of CuS nanoparticles on the wavelength of incident light at various values of the plasma frequency (a), the damping constant of free carriers (b), and the dielectric constant of the surrounding medium (c)



Dependence of the extinction coefficient of CuS nanoparticles on the wavelength at different values of the nanoparticle radius (a), the ratio between the axes of a spheroid nanoparticles (b) and the dielectric constant of the surrounding medium (c).

Conclusions

The frequency of localized surface plasmon resonance of CuS nanoparticles is directly proportional to their plasma frequency and decreases with an increase in the dielectric constant of the surrounding medium and with an increase in the damping constant of free carriers. In addition, the value of the extinction coefficient decreases with a decrease in the plasma frequency. The change in the value of the plasma frequency significantly affects the position of the localized surface plasmon resonance peak. The calculation results showed that the extinction coefficient of CuS nanoparticles decreases with an increase in the damping constant of free carriers. However, it should be noted that the position of the localized surface plasmon resonance peak in this case will not change and will be at a wavelength of about 1 μm. An increase in the refractive index of the surrounding medium leads to a shift in the plasmon absorption peak to the longer wavelengths. It was found that the plasma frequency and refractive index of the medium in which the nanoparticles are located have the highest influence on the value of the extinction coefficient of CuS nanoparticles