TEMPERATURE EFFECTS ON THE SURFACE PLASMON RESONANCE IN COPPER NANOPARTICLES

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S u m m a r y

The temperature dependences of the energy and the width of a surface plasmon resonance are studied for copper nanoparticles 17–59 nm in size in the silica host matrix in the temperature interval 293–460 K. An increase of the temperature leads to the red shift and the broadening of the surface plasmon resonance in Cu nanoparticles. The obtained dependences are analyzed within the framework of a theoretical model considering the thermal expansion of a nanoparticle, the electron-phonon scattering in a nanoparticle, and the temperature dependence of the dielectric permittivity of the host matrix. The thermal expansion is shown to be the main mechanism responsible for the temperature-induced red shift of the surface plasmon resonance in copper nanoparticles. The thermal volume expansion coefficient for Cu nanoparticles is found to be size-independent in the studied size range. Meanwhile, the increase of the electron-phonon scattering rate with the temperature is shown to be the dominant mechanism of the surface plasmon resonance broadening in copper nanoparticles.