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The influence of polarization angle on plasmonic and thermoplasmonic properties of star-shaped nanoframes for use in photothermal therapy

A Azarian and Sh Zamaninajafabadi*

Department of Physics, University of Qom, Qom, Iran

E-mail: s.zamani@stu.qom.ac.ir

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Abstract

In this study, the influence of the polarization angle on the plasmonics and thermoplasmonics properties of star-shaped gold dimer nanoframes (SGDNs) with five branches is investigated using the finite-difference time-domain (FDTD) method. Notably, varying the polarization angle shifts the first localized surface plasmon resonance (LSPR) peak, while the second plasmonic mode remains unaffected. This asymmetry arises from the anisotropic geometry of the SGDNs. The simulation results show that for light polarization parallel to the dimer axis, the SGDNs can increase the local electric field up to 117 times, and the highest temperature change in the SGDNs, with a value of $\Delta T_{max}=140°C$, is observed under this light polarization. Also, $\lambda=1800$ nm for the SGDNs is identified as an isosbestic point, which is independent of illumination polarization, and this characteristic can be utilized in photothermal therapy.

Keywords: Thermoplasmonic, Surface plasmon resonance, Photothermal therapy, Dimer nanoframes, Isosbestic points.

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