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Tuning the plasmonic response by an aberrated system

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ABSTRACT

Nanoparticles (NPs) show intensity enhancement in the near-field due to their plasmonic response when illuminated by a tightly focused beam having a high numerical aperture. The effect in intensity enhancement is influenced by the number of modes. Some specific properties such as directivity, confinement, etc. are possessed by each of these modes. The generalized Mie theory and multipole expansion method are used to describe the electromagnetic field and scattering from NPs. Multipole order (n) defines the number of modes generated on the surface of a NP. The expansion coefficient (A_n) defining the incident, and scattered field depends on the multipole order.

A linearly polarized tightly focused beam scattering through a NP supporting localized surface plasmon resonance is examined for an aplanatic lens system having a semi-aperture angle $(\alpha = 60°)$. Impact of wavefront deviation on the plasmonic response is also examined by considering a focusing system with spherical aberration. The variation in the relative strength (A_n/A_1) of the expansion coefficient with respect to multipole order in the presence of spherical aberration is observed and it is noticed that change in the plasmonic structure occurs due to tuning of higher order modes.

KEYWORDS

Mie scattering, multipole order, plasmonics, tight focusing, aberration