Optical bistability/tristability in a nonlinear core-shell magnetoplasmonic nanoparticle with magnetocontrollability

Abstract: We propose a mechanism to actively tune optical bistable/tristable behavior with the external magnetic field in nonlinear coated nanospheres. We show that such nanostructures can exhibit typical bistable/tristable phenomena near surface plasmon resonant wavelengths, which can be modified through the magnitude of external magnetic field **B**. In addition, because of the different refractive indices of the gyrotropic material for LCP and RCP waves, the corresponding results show an opposite trend with the augmentation of the magneto-optical (MO) effect. For the system consists of a MO shell and nonlinear metallic core. We demonstrate numerically that the optical bistability exists only when the volume fraction of the metallic core is larger than a critical one. The application of an external magnetic field does not only increase (or decrease) the upper/lower threshold fields but also changes the critical volume fractions. If nonlinear metallic material appears in the shell, a tunable Fano resonance which is regulated by both the incident electric field E_0 and the external magnetic field **B** can be generated in this system with properly designed geometric parameters, and it may lead to the emergence of optical tristability. In the strong nonlinear case, the self-consistent mean-field approximation is established to study the optical bistable behavior. Our studies are naturally reduced to the quasistatic results when the particle sizes are much smaller than the incident wavelengths. Such nanostructures with magneto-controllable optical bistability/tristability may be designed for us as nonlinear nanodevices, such as optical nanoswitches, optical isolators and so on.