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Tunable work function and optical nonlinearity of nanocomposites

Avesh Kumar
Dr. B.R. Ambedkar University, India

The nonlinear optical response of Au-TiO_2 nanocomposites is due to pure electronic transfer effects in Au nanoparticles. The observed nonlinearity is due to the dielectric constant of Au, which is due to the Surface Plasmon Resonance (SPR) and surface polarization between Au nanoparticles and TiO_2. The dielectric constant of Au shows maximum value at 532 nm wavelength. SPR effect of Au nanoparticles is directly related to the metal dielectric constant, therefore it is increased. The optical nonlinearity depends strongly on the dielectric constant of Au. Therefore, the optical nonlinearity increases with the increase in surface SPR peak. The absorption peak of SPR at 544 nm is inversely proportional to the work function. Therefore, we can say that the Au dopant decreases the work function that effectively increases the surface SPR absorption peak at 544 nm, so that the nonlinear response is enhanced. The systematic change in the work function with Au concentration plays a major role in optical nonlinearity. The estimated optical nonlinearity was found to increase from 3.80×10^{-6} to 9.69×10^{-6} esu with increase in Au concentrations from 0 to 1.0×10^{-2} mole. This observed increment in nonlinearity is due to the enhancement of local electric field created by excitation of SPR that affects the work function. Therefore, the SPR and work function help in tuning the optical nonlinearity. The tunable nonlinear optical response of the Au-TiO_2 nanocomposites may find applications in nonlinear optics at wavelength 532 nm and the development of materials for generating the higher order harmonics.

link.avesh@gmail.com