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**Abstract:**

The nonlinear refractive index of hybrid structure composed of metal nanoparticle, Au, and a silicon quantum dot is measured and calculated by effective nonlinear susceptibility and z-scan technique respectively. For this purpose, gold nanoparticles prepared by laser ablation in liquid method and Si quantum dot by liquid jet method. The mixture of them is exposed by 532 nm pump light in Z-scan technique, in close aperture configuration. Our results show enhanced third-order nonlinear susceptibility $χ^{3}$ and as a result nonlinear refractive index of the sample in the presence of the gold nanoparticles theoretically by the extracted nonlinearity experimentally.

***Keywords***: Nonlinear refractive index; Hybrid structure; The Z-Scan technique; Quantum dot; Metal nanoparticles.

# Introduction

Recently, hybrid nano-structures have attracted vast attention due to their novel applications and physical. Appearance of new excitations causes significant changes in optical properties of these systems.

Nonlinear characteristics of materials are essential properties needed to understand optical frequency devices such as ultrafast switches[1,2], bi-stable devices[3,4] limiters[5] and modulator[6], , the third-order optical nonlinear is used widely; experimentally and theoretically, to determine $χ^{3} $such as in the Z-Scan technique[7,8], the four-wave mixing degeneration[9], nonlinear interferometry[10] and the third harmonic generation[11–13], etc.

The optical nonlinearties in the hybrid nano-structures have the potential to increase efficiency. In the hybrid molecule composed of the metal nanoparticle (MNP) and the semiconductor quantum dot (QD), the optical of is enhanced by the effect surface plasmonics ( or collective oscillations of electrons) of coupled to exciton (bound electron-hole pair in QD ). In the presence of the external field, the surface plasmonic resonance (SPR) in the MNP the electric field and enhance the internal electric field of the semiconductor QD. Strong modifications, found as a consequence of the free-electron resonances in the metal, induce the local electric field near the surface of metal nanostructures. The large fields and the strong confinement the plasmonic resonances are supported by these systems, allowing strong interactions with other nearby photonic elements QD. The energy transfer and excitation between plasmon and exciton change the absorption and emission behavior of the structure.

There are numerous reports the hybrid structures[3,14–17]. Theoretically, the interaction between the metal nanoparticle (MNP) and the semiconductor quantum dot (SQD) has been studied in two regimes strong and weak regime. The results phenomena increasing/quenching of the induced plasmon fluorescence (the weak regime), the Fano interfere (the strong regime)[18–20], the Rabi separation (the strong regime), etc.