

Endometallofullerenes as nanoplasmonic material for plastic electronics

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Strong plasmonic-molecular resonance coupling occurs between noble metal nanoparticle and organic adsorbates when the plasmon resonance is degenerated with the molecular one. This interaction forms the basis for many fundamental studies and practical applications. Calculations show that introducing gain medium into single metal (semiconductor) nanoparticle with simple geometry can create an extremely high SERS enhancement. Molecules of endometallofullerenes present the similar type of metamaterial. We describe here direct measurements of plasmon resonance coupling on endometallofullerenes clusters.

It was found that lanthanide endometallofullerenes (EMF) form nanoclusters with preferred dimensions 50-80 nm in DMSO (DMFA) solutions (10^{-5} M) and on the clean mica surface after solvent elimination.

Plasmonic-molecular resonance coupling between EMF nanoparticles and solvent molecules in the excitation wavelength region 270-300 nm have been found. For electronics application one needs plasmonic active medium easy integrated with donor-acceptor heterojunction. To create such system plasmonic-active layer consisting of a conjugated polymer mixed with EMF nanoparticles was formed. To confirm EMF-polymer composite plasmonic behavior special polymer micron scale gratings was formed. Angle dependence of diffraction intensity for such gratings demonstrate “Wood anomaly” which is typical for plasmonic active medium.

It was found that EMF doping (4-8%) dramatically quenched luminescence efficiency of polymer composite in 600-700 nm region. Simultaneously new luminescence band in 400-480 nm region was appeared. This luminescence is very similar to one we have observed in EMF solutions. The experimental results suggest the stimulated character of emission decoupled from SP modes. Obtained results show that EMF-polymer nanocomposite attenuated for plasmonic resonance in visible region is relevant material for plastic optoelectronics and can be successfully used in the different fields of nanotechnology.

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