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Investigation of the Metal – Semiconductor Hybrid Nanostructure as an Active Medium for Laser

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Abstract Recently, many efforts have been focused on the metal or surface plasmon induced local field enhancements. The enhanced local field occurring in hot spots is particularly important to trigger low-threshold lasing resonance since it can locally enhance the pump rate of gain media.

It is believed that as the surface plasmon (SP) energy of metals matches with the emitted photon energy of the surrounding materials, the resulting resonance can lead to an energy transfer from the metal surface to the surrounding or vice versa. Amplification of SPs can be considered analogous to photon amplification in a laser, thereby suggesting novel approaches in the field of nano-optics.

In the present work, we design metallic-dielectric core-shell nanoparticles dispersed in organic dye. In this case the SPs and the resonant cavity are represented by a nanoparticle, which supports the plasmonic modes. The energy source for the spasing mechanism is an active (gain) medium that is excited externally. So we prepare Au@SiO2 (source of plasmonic modes) suspended in fluorescein dye (gain medium) which optically pumped at different powers to excite their molecules which coupled with SP modes of Au nanoparticles and then transfer its energy to it, So narrowing in dye emission is observed. Resonant energy transfer from excited dye molecules to surface plasmon oscillations is reported and emission narrowing is observed. This narrowing may be referred to spasing mechanism.

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