Investigation of LSPR energy to the performance of nano dielectric material and surrounding environment, shape and size of photosensitive nanoparticles in the simulation process

Dr.Afshin Rashid , Assistant Professor

Faculty member Islamic Azad University of Science and Research Branch, Tehran

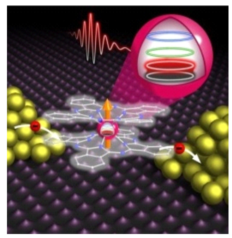
- **Abstract:**

- The LSPR energy is sensitive to the dielectric properties of the material and the surrounding environment, the shape and size of the nanoparticles. That is, if a ligand such as a protein binds to the surface of a metal nanoparticle, its LSPR energy changes. Similarly, the LSPR effects are sensitive to other changes, such as the spacing between nanoparticles, which can be changed by the presence of surfactants or ions.

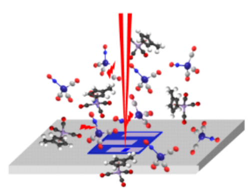
- **Keywords:** Nanostructure , nanomaterials , LSPR energy , nanoelectronic

Introduction

One consequence of the LSPR effect in metal nanoparticles is the extraordinary absorption of visible light due to the coherent oscillations of plasmons. Colloids of metal nanoparticles such as silver or gold can exhibit colors such as red, purple, or orange that are not seen in ordinary dimensions. This color change depends on the shape, size, and surrounding environment of the silver nanoparticles. In the structure of optical nanosensors, one of the nanoproperties that distinguish metal nanoparticles from these materials on a large scale is their optical properties. This is due to localized surface plasmon resonance. In simpler terms, when light strikes (metal surfaces) of any size, some of the light waves along the metal surfaces create surface plasmons. These waves actually give part of their energy to the surface electrons and cause them to vibrate (scatter) . When plasmons are produced in bulk metals, the electrons can move freely in the material without recording any traces. In nanoparticles, the surface plasmon is confined in a confined space, such that the electrons oscillate back and forth in the same direction in this small space. This effect is called localized surface plasmon resonance (LSPR). When the frequency of these oscillations is the same as the frequency of the light that creates the plasmon, the plasmon is said to be in resonance with the incident light.



Light absorption also occurs in ordinary materials that have a continuous energy band, and electrons are transferred from the valence band to the conduction band. Of course, here thermal energy can also cause electrons to be excited to the conduction band. Nanoparticles, like atoms, have discrete energy levels. Therefore, nanoparticles are also called artificial atoms. Nanoparticles below 0.1 nm, and especially semiconductor nanoparticles, are called quantum dots. By changing the size of nanoparticles, the distance between the energy levels in them changes. The smaller the size of the nanoparticles, the greater the distance between the energy levels and the forbidden band, and the larger the size of the particles, the smaller the distance between the energy levels. This makes it possible to adjust the distance between the energy levels by changing the size of the nanoparticles so that they absorb specific waves. For example, the dimensions of nanoparticles of a specific type can be adjusted so that they absorb infrared, ultraviolet, radio waves, etc. This property is widely used in the military and electronics industries.



The LSPR energy is sensitive to the dielectric properties of the material and the surrounding environment, and the shape and size of the nanoparticles. That is, if a ligand such as a protein binds to the surface of a metal nanoparticle, its LSPR energy changes. Similarly, the LSPR effects are sensitive to other changes, such as the spacing between nanoparticles, which can be changed by the presence of surfactants or ions.

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