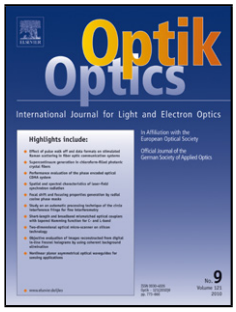

Title: Design and Simulation of High Sensitive Cylindrical Nanogear Shell Sensors According to Localized Surface Plasmon Resonance

Authors: Mahdi Sovizi, Mir Kazem Omrani

PII: S0030-4026(17)30803-3
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2017.06.126
Reference: IJLEO 59389

To appear in:

Received date: 13-2-2017
Revised date: 25-5-2017
Accepted date: 30-6-2017

Please cite this article as: Mahdi Sovizi, Mir Kazem Omrani, Design and Simulation of High Sensitive Cylindrical Nanogear Shell Sensors According to Localized Surface Plasmon Resonance, Optik - International Journal for Light and Electron Opticshttp://dx.doi.org/10.1016/j.ijleo.2017.06.126

Design and Simulation of High Sensitive Cylindrical Nanogear Shell Sensors According to Localized Surface Plasmon Resonance

Mahdi Sovizi[1,*], Mir Kazem Omrani[1,#]

[1]Faculty of Physics, Semnan University, Semnan, Iran

[*]Corresponding author Email: msovizi@semnan.ac.ir

[#]Email: kazem.omrani@semnan.ac.ir

Abstract

Localized surface plasmon resonance wavelength depends on intrinsic and environmental factors of nanoparticles. One of the most important factors is the shape of nanoparticles. The effects of nanoparticles shape on the surface plasmon resonance wavelength shift are simulated and investigated. We have observed that the sensitivity of single cylindrical nanoshell with inner and outer radiuses of 20 and 25 nm and length of 70 nm is 509 nm/RIU while the sensitive nature of nanogear with the same size is 603 nm/RIU. It is nearly four times the sensitivity of solid spherical nanoparticles and two times the sensitivity of solid nanorods.

Keywords: Localized Surface Plasmon Resonance, Cylindrical Nanoshell, and Nanogear, Sensitivity.

Introduction

Design, simulation, and manufacturing of temperature, chemical and biological agents sensors, according to surface plasmon resonance (SPR), has been of interest to many researchers and scientists, for many years. Since the surface plasmon resonance wavelength of metallic nanostructures, despite nanostructure characterizations, is dependent on the surrounding environment, such as temperature and refractive index, it can be used as a sensor.

Claes Nylander et al. (1982) have investigated the possibilities of utilizing SPR for gas detection, theoretically and experimentally. They make use of Ag film, coated on a Quartz prism as a sensor that was sympathetic to changes in the visual characteristics of the film upon gas exposure down to the ppm scale [1].

The first commercial instrument based on SPR was introduced on the market in 1991. Stefan Lofas and his colleagues used a dextran layer on the thin metal film (gold) face and improved the analytical performance of the sensing approach. This layer presents a useful method of covalently binding biomolecules for the sensing surface [2].

Jiri Homola et al. presented a review article on surface plasmon resonance sensors. They stated that research in this branch had increased ten times over a period of 5 years (1992-1997) [3].

The characteristics of surface plasmon about light were controlled via altering the metal's surface structure. These devices are used in data storage, subwavelength optics, light generation, bio-photonics, and microscopy [4]. Alexandre G. Brolo et al. (2004) used arrays of nanoholes in a gold film to show the binding of biological and organic molecules to the metallic surface. This sensor was according to the boost light transmission via arrays of nanoholes in gold films. They found the sensitivity 400 nm per refractive index unit [5].