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Department of Laser and Optoelectronics Engineering

Optical Fiber Sensors Based on TCos Nanoparticles Doped by Gold Nanorods

Thesis Submitted to the Department of Laser and Optoelectronics Engineering, University of Technology in Partial Fulfillment of the Requirements for Master Degree of Science in Optoelectronics Engineering

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Abstract

Fiber – optic sensor became popular in many applications. Sensing biological, chemical, environmental changes can be accomplished by building simple and cheap elements. In this project, a fiber – optic sensor with modified cladding layer has been suggested. Two configurations have been proposed which they are SM – SM – SM and SM – MM – SM. A 14 samples were prepared by depositing the sensing regions with different nanoparticles materials. Three materials have been prepared to perform modified refractive index difference instead of the cladding layers which they are: Gold, Zinc Oxide, and ZnO/Au. The ZnO/Au nanoparticles prepared using pulse laser ablation technique at two wavelengths: 532nm and 1064nm for six hours to study the effect of wavelength on sensing performance. 14 ablated samples are deposited for 6 hours to form ZnO/Au deposited fiber – optic sensor. The structural, morphological, photoluminescence properties of the prepared materials are studied and analyzed using X – ray Diffraction (XRD) pattern of the gold nano – rods prepared at 532nm and 1064 nm. Comparatively, two peaks orientated at 2θ=38.13, and 44.22 which they correspond to the (fcc) lattice's standard Bragg reflections (111) and (200), ZnO there are five peaks ordinated The most obvious associated as100,101 associated with the angle 2θ = 32.53, 35.84. Transmission Electron Microscopy (TEM) Nanorods of 6.7μm length and 100nm diameter are distinguishable at ablated wavelength of 532nm and the length 5.5μm and 200nm diameter of 1064, ZnO ablated at 1064 the nanoparticles tend to become larger in sizes and allocate close to each other the diameter 62-65nm, at wavelength 532nm nanoparticles are smaller in sizes and the diameter 48nm.

The results showed that when the sensing region (SMF or MMF) was deposited with ZnO/Au at 1064nm ablation wavelength, higher sensing

performance was recorded. However, The presence of higher order modes is affected by the coated layer of ZnO/Au in multimode optical fibers, resulting in a higher spectral shift than in single mode optical fibers. Further, the sensing ability for MMF sensor gave some flat – top spectral behavior of about 6nm constant spectrum that can be used for multi – wavelength sensing application with bandwidth of 6nm. These results have been taken when the sensor immersed at NaCl solution of 50% concentration.