# ABSTRACT

The main trend in optical biosensors is the development of fast, sensitive, robustness and flexible. This device is used to detect changes in the properties of liquids, such as absorption or refractive index. In general, there are two photonic crystal (PCF) types include solid and hollow cores. The presence of PCF air holes serves both to confine electromagnetic waves within the fiber core and to manipulate the characteristics of their propagation. The potential for the PCF to be filled and immersed with liquids may enhance its optical characteristics. The effect of hollow-core PCF liquid filling has been theoretically studied using the finite element method. In this thesis, Infiltrated HC-800 PCFs with different liquids (Water, Human Blood Plasma, colon Tissue, liver Tissue, and pentanol) were applied.

In experimental work, the Gold nanoparticles (NPs) were deposited on the HC-PCF to enhance the sensitivity by used the principle of Surface Plasmon resonance (SPR). The first prepared the PCF by etching it and then have been deposited the gold NPs on the etched area of PCF fiber. Before that, the gold nanoparticles were prepared by using the Pulsed laser ablation method at 532 nm and 1064 nm. From AFM the NPs appeared well distributed and average size particles were 30 nm and 44 nm at 532 and 1064 nm, respectively.

Confinement loss was computed theoretically, and Amplitude sensitivity was computed theoretically by considering the change in confinement loss for the fundamental mode of liquid-filled PCF. The results of the non-deposited PCF sensor showed that the confinement loss decreased to shorter wavelengths with increased refractive index of the liquids. The maximum amplitude sensitivity was found to be 769.57 $RIU^{-1}$ in Human blood Plasma, and the best electric field was found to be 400 V/m. In the same liquid, when used the deposited PCF with a gold layer, the maximum amplitude sensitivity was found to be 975.53 $RIU^{-1}$ at the best electric field of 477 V/m. But the confinement loss decreased toward the higher wavelengths with increased refractive index of the liquids. Photonic crystal fiber has been taken laser-guided by wavelengths from (400 nm -1200 nm) inside the optical crystal fiber using COMSOL Multiphysics 5.3 program.