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Terahertz Glucose Sensors Based on Photonic Crystal Pillar Array

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Abstract : Optical biosensors are dominant alternative for traditional analytical methods, because of their small size, simple design and high sensitivity. Photonic sensing method is one of the recent advancing technology for biosensors. It measures the change in refractive index which is induced by the difference in molecular interactions due to the change in concentration of the analyte. Glucose is an aldosic monosaccharide, which is a metabolic source in many of the organisms. The terahertz waves occupies the space between infrared and microwaves in the electromagnetic spectrum. Terahertz waves are expected to be applied to various types of sensors for detecting harmful substances in blood, cancer cells in skin and micro bacteria in vegetables. We have designed glucose sensors using silicon based 1D and 2D photonic crystal pillar arrays in terahertz frequency range. 1D photonic crystal has rectangular pillars with height 100 μm, length 1600 μm and width 50 μm. The array period of the crystal is 500 μm. 2D photonic crystal has 5×5 cylindrical pillar array with an array period of 75 μm. Height and diameter of the pillar array are 160 μm and 100 μm respectively. Two samples considered in the work are blood and glucose solution, which are labelled as sample 1 and sample 2 respectively. The proposed sensor detects the concentration of glucose in the samples from 0 to 100 mg/dL. For this, the crystal was irradiated with 0.3 to 3 THz waves. By analyzing the obtained S parameter, the refractive index of the crystal corresponding to the particular concentration of glucose was measured using the parameter retrieval method. Refractive indices of the two crystals decreased gradually with the increase in concentration of glucose in the sample. For 1D photonic crystals, a gradual decrease in refractive index was observed at 1 THz. 2D photonic crystal showed this behavior at 2 THz. The proposed sensor was simulated using CST Microwave studio. This will enable us to develop a model which can be used to characterize a glucose sensor. The present study is expected to contribute to blood glucose monitoring.

Keywords : CST microwave studio, glucose sensor, photonic crystal, terahertz waves
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