

Abstract

Laser radiation is widely used in several applications like medicine, biology and industry. Laser biosensor is one of the tools in the biological applications.

In this thesis, lasers with different wavelengths have been used for different biological applications such as blood and urine tests, based on Mach-Zehnder interferometer.

First, the absorption spectra of human blood and urine samples were measured using UV- NIR spectrophotometer. It was found that the highest absorption of the blood sample was at the wavelengths range (470 – 590) nm, while the highest absorption of the urine sample was in the range (590–670) nm. A frequency doubled Nd:YAG laser with (532nm) as a laser source with input power of (12.2 nw). Also a red diode laser with (650nm) wavelength with (47 nw) input power was required as a laser source in the laser biosensor for the urine test.

A laser biosensor is designed with different lengths of solid core photonic crystal fibers (LMA-10) (1.5cm, 1cm and 0.5cm) to be used for different tests. For the blood test, the highest sensitivity of 153 ABS/RIU was found for the (1.5cm) length.

The results for different urine samples (males, pregnant and nonpregnant females) showed that the increasing of urine sample components leads to a decrease in the intensity of the laser beam.

The effect of pregnancy has been investigated. The results showed that the increasing of pregnancy hormones leads to increasing the refractive index for urine sample and decreasing in the intensity of the output laser beam. From this test, the calibration curve of laser biosensor for pregnancy test has been found. The sensitivity of pregnancy sensor is (58.407 ABS/RIU).

In the blood test part, the results showed that the increasing of the hemoglobin concentration lead to increasing the absorbance of the blood sample for the laser beam. A calibration curve of the laser biosensor for hemoglobin concentration measurement is also found.

Moreover, the biosensor was used for the detection of different types of anemia such as iron deficiency and aplastic anemia. Blood samples been taken from healthy people and others suffering from anemia. The results showed that the presence of anemia led to increasing the output intensity of the laser beam. The sensitivities of iron deficiency and aplastic anemia are 28.934 ABS/ RIU and 23.78 ABS/RIU, respectively.