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Optical Biosensor for The Detection of Gram Positive and Gram Negative Bacteria Using Laser and Other Light Sources

Thesis
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Abstract

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

In this dissertation, a research study using an optical biosensor has been utilized for distinguishing between gram positive and gram negative bacteria.

An optical biosensor was designed using coreless fiber (CF) and sources of different wavelengths with two fiber shapes (straight and U-bent). They were used to distinguish between gram positive *Staphylococcus aureus* (*S. aureus*) and gram negative bacteria *Escherichia coli* (*E. coli*), based on multimode fiber-no core fiber-multimode fiber (MMF-NCF-MMF) evanescent wave sensor structure.

First, the absorption spectra of gram positive and gram negative bacteria samples were measured using a UV- NIR spectrophotometer. It was found that the highest absorption of the *Staphylococcus aureus* sample was at the wavelengths range (418 – 475) nm, while the highest absorption of the *Escherichia coli* sample was in the range (418 – 445) nm. Blue diode laser (405 nm) wavelength, He-Ne laser (632.8 nm), red diode laser (659 nm), halogen lamp (400-1030 nm) and blue LED (429 nm) have been used in this work.

The results for different bacterial samples (*S. aureus* and *E. coli*) showed different shift of the transmitted wavelength for each kind where a blue shift of the transmitted wavelength was found for gram positive bacteria (wavelength decreases) and a red shift of the transmitted wavelength was found for gram negative bacteria (wavelength increases).

It was found that the shift of transmitted wavelength was increased by increasing the wavelength of the source, and more accurate results were observed with the U-bent optical fiber structure of the sensor, where the highest wavelength shift was found with the U-bent optical fiber with 659nm.