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Photonic crystal-based biosensing for TB detection

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Over the last three decades, biosensors based on photonic crystals (PhCs) have been developed and continue to receive significant recognition owing to their distinctive electromagnetic properties and broad applications. Studies that have used refractive index as a parameter to design optical biosensing devices based on PhCs have resulted in optical devices that are sensitive with quick response time for small variations in samples. In this study, a 1-dimensional (I-D) PhC biosensor chip was developed for the diagnosis of TB. A pathogen-specific mycolic acid (MA) TB biomarker was studied based on the detection of refractive index changes on functionalised PhC biosensing surface. The MA biomarker was used as the biorecognition element to capture anti-mycobacterium tuberculosis antibodies, and a custom-built optical biosensing setup was used for optical biosensing to monitor biomolecular interactions between the antigen and antibody. Functionalised and successfully characterised gold nanoparticles (AuNPs) were introduced on the biosensing surface to enhance the detection signal. The biosensing surface was further characterised using atomic force microscopy (AFM), scanning electron microscopy (SEM), and energy-dispersive X-ray (EDX) spectroscopy. Analysis of biomolecular binding events on the biosensing surface was achieved using the optical biosensing setup by measuring transmitted light through the biosensor chip, and successfully distinguishing differences between the experiment and control samples. From our findings, it was realised that mycolic acid antigen can be used as a biomarker for active TB, and can be successfully immobilised on a biosensing surface to capture anti-mycobacterium tuberculosis antibodies. It was evident that PhC-based optical biosensing technique was successful in detecting small refractive index changes on the biosensing surface for the diagnosis of TB. These results pave the way toward the development of a PhC-based point-of-care (POC) diagnostic device for TB.

Apply to be considered for a student ; award (Yes / No)?

Yes

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PhD

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