



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Phurpa Dema Thungon

Roll Number : 146106001

Programme of Study : Ph.D.

Thesis Title: Exploring optical sensors for hydrogen peroxide on silk and paper platforms using chemical dye, peroxidase and gold nanoclusters as signal generating systems

Name of Thesis Supervisor(s) : Prof. Pranab Goswami

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SHORT ABSTRACT

The thesis focuses on the development of optical sensors for the detection of hydrogen peroxide (H_2O_2) using silk and paper as platforms and peroxidase, protein stabilized gold nanoclusters and organic dye as signal generating systems. Based on the investigation we put forward three independent proofs of concepts for optical detection of H_2O_2 namely, (A) Development of a paper-based sensor for optical detection of H_2O_2 using an organic fluorophore, and its application for developing a paper-microfluidic fluorescent-based alcohol biosensor. The fluorophore on interaction with H_2O_2 showed fluorescent emission shift from blue to red/orange and was embedded on a paper disc to prepare a simple optical H_2O_2 sensor. Further, a microfluidic paper-based analytical device (μ PAD) was designed using the fluorophore-infused paper for sensing ethanol. (B) Development of peroxidase-based colorimetric detection for H_2O_2 and the application of this sensor to develop a silk-paper hybrid platform-based colorimetric alcohol biosensor for on-site application. Here, peroxidase was co-entrapped with alcohol oxidase (AOx) within the same silk fibroin (SF) film to develop a bi-enzyme film, which showed good stability and activity. Lastly, (C) Fluorometric and colorimetric detection of H_2O_2 using protein stabilized gold nanoclusters (AuNCs). This study used catalase (Cat) to synthesize two types of Cat-Au NCs. The interactions of the NCs with H_2O_2 were then investigated and the concept was translated for detecting H_2O_2 . The performances of all the developed sensors were examined by using different parameters such as limit of detection (LoD), dynamic range and operational stability. We critically evaluated our works and forwarded our views on the future scopes for translating these proofs of concept to commercially viable products.