Title: Development of Porous Thin Film based Multiparametric Glucose Sensors

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Abstract:

Diabetes is a metabolic disease causing high blood sugar level. Normal blood glucose range is in between 3.9-5.6mM. Higher than 11.1mM and lower than 3.9mM is considered as hyperglycemia and hypoglycemia respectively. In the thesis, porous thin film based optical glucose sensors have been studied extensively inside pathological range of 1-30mM.

Optical detection techniques are of great interest in biosensor platform due to their accuracy, sensitivity, stability and robustness. Multiparametric sensors are preferred over single parametric ones, as they produce extremely reliable and precision measurements with additional advantage of better selectivity. So, a cost effective, multiparametric optical measurement system based on MATLAB image processing environment has been designed and developed for glucose sensor measurements.

Porous Silicon (PS) has some remarkable structural and surface properties. Its high surface to volume ratio provides increased space for biomolecular interaction, thus increasing overall sensitivity. PS thin films on Silicon substrate have been fabricated by electrochemical etching procedure and the samples were characterized and optimized for biosensing application. As PS sensors are non-transparent in visible spectra, they can only provide reflectance, absorbance and scattering information. To add more parameters to the multiparametric system, polymer based composite thin films have been studied. Chitosan-Silica nanocomposite (CSNC) thin films on glass substrate are optically semi-transparent and they provide both reflection and transmission image information, thus enabling total five interlinked parameters for simultaneous analysis. So, CSNC sensors were also fabricated, characterized and optimized for biosensing application. Surface functionalization is a crucial part for selective detection of target analytes. Glucose oxidase (GOX) is a glucose selective enzyme which produces gluconic acid and hydrogen peroxide upon contact with glucose molecules. GOX is immobilised on PS surface by physisorption process and CSNC films attach GOX molecules by Glutaraldehyde crosslinking.

Finally, surface functionalized PS and CSNC glucose sensors have been analysed in the developed optical setup and a comparison between the two sensors has been presented in terms of different biosensor characteristics. It was found that PS sensors were suitable for multi-time use and long storage time, while CSNC sensors showed better sensitivity, response time and LOD.

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