The Effect of Ionic Liquid (BMIM-BF_4) on Screen-Printed Glucose IrC biosensor modified with Crosslinking Chitosan Matrix

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Ionic liquid (IL) possesses tunable behaviors based on asymmetric ion-pair combinations. Along with its unique characteristics, such as high conductivity and wide potential window, it will be desirable to applying IL into the fields of bio-electrochemistry [1]. More importantly, incorporating IL into the development of modified electrode can be potentially valuation for biosensing application [2].

In this research, glucose biosensor was employed as the study model for a thick-film screen-printed iridium-carbon (IrC) electrode as an electrochemical transducer element. The biosensor platform was modified using glutaraldehyde (GA)-crosslinking chitosan (CHI) matrix for enzyme immobilization. Glucose oxidase (GOx) enzyme solution was prepared with 1% (v/v) ionic liquid (1-Butyl-3-methyl-imidazolium tetrafluoroborate [BMIM-BF_4]), in order to explore the effect of IL on both electrochemical and spectrophotometric performance of the proposed glucose sensor.

H_2O_2 is the byproduct and an electroactive species biocatalyzed via immobilized GOx. In this study, electro-reduction of the enzymatically-liberated H_2O_2 was utilized for glucose quantification. Glucose was amperometrically detected at -0.1V versus the printed Ag/AgCl as shown in Figure 1. With the assistance of IL, the sensitivity was achieved 1.33-fold higher than that without IL modification on GOx. Furthermore, the Michaelis-Menten constant (K_M) and the detection limit both were lowered after incorporating IL. Interferents were also investigated during glucose assays and their effects were effectively minimized in the reduction mode.

The stability (shelf life) of the proposed biosensor was evaluated intermittently based on amperometric measurement of 0.25 mM glucose. The incorporation of IL (BMIMBF$_4$) prolonged the shelf life of the biosensor and retained over 88% of the activity of the immobilized GOx after 20 days, shown in Figure 2. UV–vis spectrophotometric assessment of GOx containing IL (BMIM-BF_4) was investigated in a CHI-GA mixture with the same proportions used for the immobilization of GOx. The UV-vis spectrum of GOx in the presence of IL modification still remained well at absorption peak of 450 nm as shown in Figure 3.

Along with IL (BMIM-BF_4) incorporation, the glucose biosensor presented improved and attractive features on high sensitivity, high biological affinity (low K_M), low detection limit and long-time storage life.

Reference:

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2. Opallo, M., J. Electroanal Chem. **2011**, 656, 2–16.

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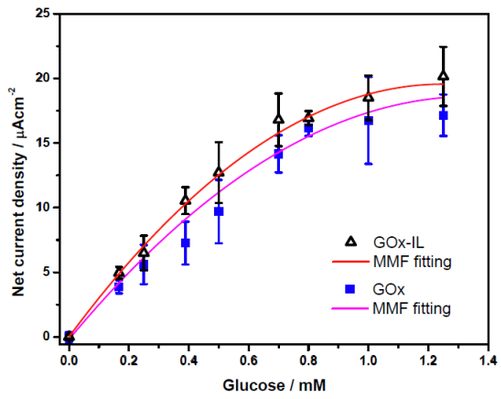

Figure 1. Sensor response of glucose detection using GOx/CHI-GA/IrC biosensor in the presence/absence of IL (BMIM-BF_4) modification

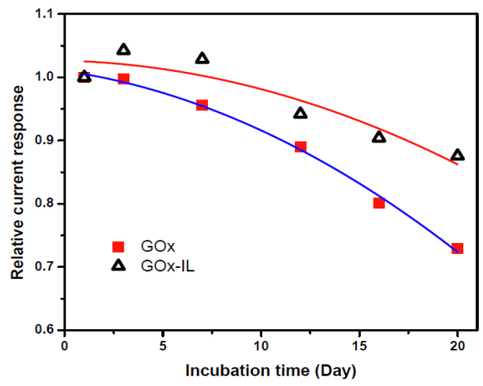

Figure 2. Comparison of stability of GOx/CHI-GA/IrC biosensor in the presence/absence of IL (BMIM-BF_4) modification

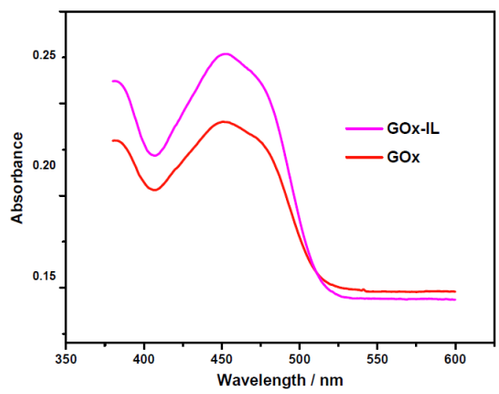

Figure 3. UV-vis spectra of GOx/CHI-GA mixture in the presence/absence of IL (BMIM-BF_4) modification

Acknowledgement: This work is partially supported by the NSF Grant #100768, DOE-Air Force Office of Scientific Research-MURI 2011-Nanofabrication and the Delta Environmental and Educational Foundation. The authors express their appreciation to the staff of the Electronics Design Center of CWRU for their technical support.