

ABSTRACT

The development of advanced technology for medical and biological diagnostician is significantly increased. Electrochemical biosensors become more desirable since it offered an attractive replacement for the bulky and expensive analytical instruments. The design and fabrication of a novel electrochemical biosensor using microfluidic chip are the aims of this research. Additionally, the effects of the design parameters including the microchannel size and electrode size are to be investigated. The designed biosensor is consisting of two chips; a microfluidic chip which was made of PMMA (polymethyl methacrylate) where the microchannel is created. The second chip is made of glass, where the three electrodes cell was fabricated. This design offered more flexible testing and multi diagnostician at the same chip. The performance of such biosensor is then examined using the electrokinetic and cyclic voltammetry techniques in order to ensure the quality of the biosensor. The effect of the microchannel size on the performance of the sensor was then investigated by conducting cyclic voltammetry testing for four different sizes of the fabricated channels at electrode size of 100 μ m. Likewise, similar channels sizes were investigated at 200 μ m electrode size. The fabricated chips morphology showed the smoothness on the surface in both the microchannel chip and the electrode chip. No defects on the fabricated chips were reported. The electrokinetic properties of the microchannel were found to be affected by the size of both the microchannel and the electrode. The highest sensitivity of the sensor was reported at microchannel size of 700 μ m and electrode size of 200 μ m. High accuracy and fast responding electrochemical biosensor are expected to be produced through the optimization of the microchannel size and the electrode surface area.

ABSTRAK

Perkembangan teknologi maju untuk diagnostik perubatan dan biologi meningkat dengan ketara. Biosensor elektrokimia menjadi lebih wajar kerana ia ditawarkan pengganti yang menarik bagi instrumen analisis besar dan mahal. Reka bentuk dan fabrikasi yang biosensor elektrokimia novel menggunakan cip microfluidic adalah Tujuan kajian ini. Selain itu, kesan parameter reka bentuk termasuk saiz saluran mikro dan saiz elektrod yang akan disiasat. The biosensor direka adalah terdiri daripada dua cip; cip microfluidic yang diperbuat daripada PMMA (polymethyl metakrilat) di mana saluran mikro yang dicipta. Cip kedua diperbuat daripada kaca, di mana sel tiga elektrod telah dipalsukan. Reka bentuk ini ditawarkan ujian yang lebih fleksibel dan pelbagai diagnostik pada cip yang sama. Prestasi biosensor itu kemudiannya diperiksa menggunakan teknik voltammetri elektrokinetik dan kitaran untuk memastikan kualiti biosensor ini. Kesan saiz saluran mikro ke atas prestasi sensor kemudiannya disiasat dengan menjalankan ujian voltammetri berkitar selama empat saiz yang berbeza daripada saluran yang direka pada saiz elektrod $100\mu\text{m}$. Begitu juga, saluran sama saiz telah disiasat pada saiz elektrod $200\mu\text{m}$. Yang direka morfologi cip menunjukkan kelancaran di permukaan di kedua-dua cip saluran mikro dan cip elektrod. Tiada kecacatan pada cip direka dilaporkan. Sifat-sifat elektrokinetik daripada saluran mikro yang didapati dipengaruhi oleh saiz kedua-dua saluran mikro dan elektrod. Kepekaan tertinggi sensor dilaporkan pada saiz saluran mikro 700 dan saiz elektrod $200\mu\text{m}$. Ketepatan yang tinggi dan cepat bertindak balas biosensor elektrokimia dijangka akan dihasilkan melalui pengoptimuman saiz saluran mikro dan kawasan permukaan elektrod.