UNIVERSITI TEKNOLOGI MARA

AMPEROMETRIC DETECTION OF PHENOL BASED ON TYROSINASE ZrO_2 NPs BIOSENSORS

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ABSTRACT

Ionic liquid (IL) is an effective capping agent to reduce agglomeration and further improve the size and morphology of the synthesis metal oxide nanoparticles (MONPs). In this work, two type of IL with different anion moiety were used to synthesis zirconium oxide nanoparticles (ZrO_2 NPs) involving 1-butyl-3-methylimidazolium trifluoroacetate ($BmimCF_3COO$) and 1-butyl-3-methylimidazolium nitrate ($BmimNO_3$). For comparison purpose, the properties, morphology, crystallinity, size, and shape of both ZrO_2 NPs were analysed by Fourier-Transform Infrared (FTIR), Ultraviolet-Visible Spectroscopy (UV-VIS), Transmission Electron Microscopy (TEM), Field Emission Scanning Electron Microscopy-Energy Dispersive X-Ray (FESEM-EDX), and X-Ray Diffraction (XRD). Analysis from XRD analyses shows the average particle size for ZrO_2 NPs synthesis using $BmimCF_3COO$ and $BmimNO_3$ were 10.60 nm and 12.82 nm respectively. This is further confirmed by the analyses from TEM reveal the size of 10 and 12 nm for ZrO_2 NPs synthesis using $BmimCF_3COO$ and $BmimNO_3$ respectively using histogram plot. Consequently, for extracellular measurement of amperometric phenol-based biosensor, ZrO_2 NPs synthesis utilising both IL were used as a fabricated materials onto the screen-printed carbon electrode (SPCE) and immobilised using glutaraldehyde (GA), tyrosinase (Tyr). The developed biosensor displayed outstanding linearity for phenol within the range of 10 and 90 µM (R^2 = 0.991) range for SPCE/ ZrO_2 NPs-$BmimCF_3COO$/GA/Tyr phenol based biosensor while for SPCE/ ZrO_2 NPs-$BmimNO_3$/GA/Tyr it exhibits a linear range of 5 to 75 µM (R^2=0.9976). SPCE/ ZrO_2 NPs-$BmimNO_3$/GA/Tyr phenol based biosensor have higher sensitivity as compared to SPCE/ ZrO_2 NPs-$BmimCF_3COO$/GA/Tyr which were 18.38 nA/mM and 10.83 nA/mM respectively. In addition, SPCE/ ZrO_2 NPs-$BmimNO_3$/GA/Tyr phenol based biosensor reported a lower limit of detection (LOD) of 2.73 µM while for SPCE/ ZrO_2 NPs-$BmimCF_3COO$/GA/Tyr it gives an 9.47 µM, under optimal conditions. The results also shows excellent repeatability, reproducibility, anti-interference properties, and up to 20 days storage stability for both biosensors. In this case, both biosensors are successfully applied for determination of real water sample such as river, tap water, and drinking water. For forthcoming analysis, it might be possible to run the optimization during the synthesis process such as effect of pH, effect of calcination temperature, and amount of IL added in which it might give difference morphology or size which may affect the NPs performance on the developed biosensor.

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