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Amperometric biosensors for cancer maker detection using novel dumbbell-like gold-magnetite nanocomposites

An ultrasensitive amperometric immunosensor for the detection of cancer biomarker, α-fetoprotein (AFP), was fabricated using Au/chitosan modified glassy carbon electrode (GCE) and antibody-functionalized dumbbell-like Au-Fe_3O_4 heterostructures as sensing platform and immuno-labels, respectively. To fabricate the labels, nano-Au NPs were first epitaxially grown onto Fe_3O_4 surface to form the dumbbell-like Au-Fe_3O_4 followed by conjugation of secondary antibody onto Au surface (Au-Fe_3O_4-Ab2). Results showed that the GCE modified with chitosan produced high electrochemical response by conjugation of more Au-Ab1 and the dumbbell-like Au-Fe_3O_4 served as a dual-probe to immobilize Ab2 onto Au as well as to reduce H_2O_2 by Fe_3O_4, resulting in the enhancement of signal amplification. The prepared Au-Fe_3O_4/Ab2/AFP/Ab1/Au/chitosan/GCE immunosensors exhibited a good analytical performance in the presence of 10 mM H_2O_2 with wide dynamic range of 4 orders of magnitude (0.01–40 ng mL^{-1}) and low detection limit of 2.3 pg mL^{-1}. In addition, the dumbbell-like Pt-Fe_3O_4 nanoparticles have been used to fabricate the amperometric biosensors for detection of dopamine. The Pt-Fe_3O_4-based electrode is linearly dependence on dopamine concentration in the range of 10-850 μM with the detection limits of 0.13-7.22 μM. Results obtained in this study clearly demonstrate that the dumbbell-like metal-magnetite biosensor is a promising biosensing platform for highly sensitive detection of tumor makers and neurotransmitters.

Biography

Ruey-an Doong earned his PhD in Environmental Engineering from the National Taiwan University, Taiwan in 1992. He joined the Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan in 1994. He served as the Department Head in 2008 and Dean of the College of Nuclear Science, National Tsing Hua University in 2011. Currently, he is a Full Professor in the Institute of Environmental Engineering, National Chiao Tung University, Taiwan. His research interest lies in the areas of environmental chemistry and environmental nanotechnology.

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