Highly-sensitive Cholesterol Biosensors Based on ZnO Nanostructures

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Abstract

The determination of cholesterol is of vital importance since high serum cholesterol level is related to various clinical disorders, such as heart disease, coronary artery disease, arteriosclerosis, hypertension, cerebral thrombosis, and etc. In addition to this, the cholesterol and its fatty acids are also important constituents of nerve and brain cells. Hence, the development of reliable and high sensitive method for the active and fast determination of cholesterol is an active research now days. This paper reports the fabrication of highly sensitive cholesterol biosensor based on cholesterol oxidase (ChOx) immobilization on well-crystallized flower-shaped ZnO structures composed of perfectly hexagonal-shaped ZnO nanorods grown by low-temperature simple solution process. The fabricated cholesterol biosensors reported a very high and reproducible sensitivity of 61.7 $\mu A \mu M^{-1} cm^{-2}$ with a response time less than 5 sec and detection limit (based on S/N ratio) of 0.012 µM. The biosensor exhibited a linear dynamic range from 1.0 ~ 15.0 µM and correlation coefficient of R = 0.9979. A lower value of apparent Michaelis-Menten constant (K_m^{app}), of 2.57 mM, exhibited a high affinity between the cholesterol and ChOx immobilized on flower-shaped ZnO structures. Moreover, the effect of pH on ChOx activity on the ZnO modified electrode has also been studied in the range of 5.0 ~ 9.0 which exhibited a best enzymatic activity at the pH range of 6.8 - 7.6. To the best of our knowledge, this is the first report in which such a very high-sensitivity and low detection limit has been achieved for the cholesterol biosensor by using ZnO nanostructures modified electrodes.