

Effect of nanostructure on the urea sensing properties of sol-gel synthesized ZnO

ABSTRACT

Urea sensing properties of zinc oxide in thick film form are presented here. Zinc oxide thick films were prepared on Al-sheet by conventional doctor blade method using organic additives. Flower-like structure and nanobelts of ZnO was synthesized by solution method using zinc acetate dihydrate and sodium hydroxide. Structural morphology significantly changed with precursor concentration (0.3-0.5 M) from a belt to flower-like structure. Urease was covalently attached with zinc oxide (by soaking in urease solution containing 100 units for 3 h). In general, conductivity of film increases after urease immobilization. The urease immobilized films were found sensitive to urea concentration from 1 mM to 100 mM. Three different sensitivity regions are observed viz. (i) lower concentrations (below 10 mM); (ii) linear region up to 50 mM: and (m) a saturation region above 50mM. Sensors are extremely sensitive in region (i), Nanobelt structure of ZnO resulted in highest urea sensitivity. Sensors exhibited linear response when tested for different concentration of human urine in buffer solution(1 :9 to4:6).The sensor responses are reproducible, reliable, reversible and selective. with a response time of 6s.

I. Introduction

The human senses are the best examples of specialized neural sensors. Enzymatic electrochemical biosensors have attracted researchers attentions due to their potential applications and improvement in performance with nano-technological approach.

In last few decades, the development of enzyme-based biosensors has been a topic of considerable interest due to their potential applications. since the spectroscopic methods are laborious and often not useful in on line monitoring system. The inconvenience was overcome by the use of electrochemical methods for biosensing. The most widespread example of a commercial biosensor (third generation sensor) is the blood glucose biosensor, which uses an enzyme to breakdown the blood glucose. breaking

the sugar down into its metabolites. Glucose oxidase (GO_x) is a dimeric protein which catalyzes the oxidation of beta-D-glucose into D-glucono-1,5-lactone which then hydrolyzes to gluconic acid. In this process, it transfers an electron to the electrode which is used as a measure of the blood glucose concentration [1-7].

Among a large number of enzymes used for biosensor construction, urease is an important part in most enzyme-based sensor development to fulfill the growing demand for urea detection. Urea ($(NH_2)_2CO$) is basically an organic compound of carbon, nitrogen, oxygen and hydrogen. Most organisms deal with the excretion of nitrogen waste originating from protein and amino acid catabolism. The normal level of urea in serum is 3-7 mM (15-40mg/dl). In patients suffering from the renal insufficiency, the urea concentration in serum is from 30mM to 80mM (180-480 mg/dl) and at the level above 180 mg/dl, the hemodialysis is required. However, Too high concentration in the blood can cause damage to body organs.

Therefore, its analysis is of considerable importance. An important part for biosensors construction is to immobilize biomolecules on the transducer without changing their structural conformation and their activity. The immobilization feature can govern the performance and reliability of the obtained biosensor. The host material generally used for biosensor development includes clays, layered double hydroxides (e.g, ZnAl). Nanoporous alumina membranes, polymers, tin oxide, etc. [8-16]. Researchers are putting extensive effort in exploring/understanding the biocompatibility of inorganic (especially metal oxide) nanomaterials synthesized by various techniques. There are few reports that have shown the promising development of the third generation biosensors using such materials [17-20]. Nanomaterials offer unique advantages in immobilizing enzymes due to increase surface reactivity, preserving enzyme activity due to the microenvironment.

Zinc oxide: a versatile semiconductor, which has attracted attention for its wide range application in the field of solar cells luminescent, electroacoustic devices, etc.

