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Cyclic Voltametry Study of PANI/ZnOUrease Based Biosensor with Stainless Steel Electrode as Transducer

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Abstract: *The electrochemical characteristic Cyclic Voltametry (CV) was studied for Electrodeposited Polyaniline (PANI)/ZnOnano composite onto a stainless steel transducer. The Cyclic Voltametry was studied during electrode position of PANI/ZnO on the stainless steel electrode. Good cyclic voltammogram for 15 wt% composition was observed as compared to others. The PANI/ZnO film also offers a more symmetrical voltammogram, with oxidation starting at a lower potential (0.05 to 0.08 V) compared to pure PANI, indicating that the presence of the ZnO promotes the electron-transfer of the oxidation process. Cyclic Voltametry of PANI/ZnO/Urease electrode shows the oxidation potential peaks occurs in CV of ZnO-PANI 15% film depicts the oxidized potential at around 0.2V, which is at higher potential as compared to other lower weight %, indicating larger surface area and larger potential window as compared to others. The magnitude of peak current gets increased with increasing concentration of ZnO, which ensure quick response time of the sensor. The CV of PANI/ZnO/Urease in potential window of -0.1 to 0.1V shows resistive effect of PANI. Also, the cyclic voltammogram of PANI/ZnO/Urease 15% shows more ohmic behavior as compared to other compositions and PANI..*

Keywords: Polyaniline, Zinc oxide, Urease, Cyclic Voltametry, Stainless steel, biosensor

I. Introduction

The detection of heavy metal ions in natural water, soil and air has become very important because of their accumulation and storage in living organisms may cause serious disorder in the metabolic activities. Recent research has shown importance of biosensors in the detection of these hazardous heavy metal ions. The transducer is a key component in the construction of biosensor. A certain number studies have been reported for the use of interdigitated thin film electrodes [1], Titanium, Chromium, Aluminium, Platinum, mild steel[2,3]etc as a transducer element. But, these electrodes are undesirable for operation with biological liquids since these electrodes have low sensitivity to changes in the ion strength of solution and reach conductivity saturation in a short time. The stainless steel electrodes are however less costly and can easily be available. The polyaniline can easily deposited on stainless steel by electropolymerization[4]. The Electropolymerized layer on stainless steel electrode immobilized with the enzyme gave water-insoluble, transparent film, with a high enzyme activity [5].The advantage of nanostructure ZnO[6] used modified transducer surface as compared to other metal oxides such as CeO2, SnO2, TiO2, FeO2 and ZrO2 is their unique ability to promote faster electron transfer between electrode and active site of desired enzyme. The ZnO nanostructures an important widely used due to their unique properties including high specific surface area, high catalytic efficiency, strong adsorption ability, high isoelectric point (IEP 9.5), wide band gap (3.37 eV), biocompatibility and high electron communication features[7].Also, less toxicity, high chemical stability and high electron transfer capability make ZnO as a favorable surface for immobilization of enzymes such as Urease. Since biosensors are designed by using biological elements such as enzymes, they can be inhibited by heavy metal ions [8]. Generally, urease was used as the enzyme inhibitor by heavy-metal ions [9, 10, 11] because of its low cost easy availability. The enzymatic reaction of urea with urease is shown in the following equation

$$NH_2CONH_2 + 3H_2O \xrightarrow{\text{Urease}} 2NH_4^+ + HCO^{-3} + OH^-$$

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