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Fabrication of a novel MOF template-derived $ZnCo_2O_4$ composite for the non-enzymatic electrochemical detection of glucose

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ABSTRACT

Glucose detection is one of the frequently occurring research due to increased cases of diabetes and the need for continuous monitoring of glucose. MOF template-derived nanocomposites have shown their potential in the field of sensors to address the shortcomings due to selectivity and sensitivity of the present-day sensors. A novel MOF template-derived $ZnCo_2O_4$ Composite ($ZnCo_2O_4$@MOF) sensing was designed and prepared in this study, and it was employed as an electrochemical sensor for the non-enzymatic detection of glucose with good selectivity and stability. The electrochemical characteristics of the present sensor were evaluated using a cyclic voltammetry (CV), differential pulse voltammetry (DPV), electrochemical impedance spectroscopy (EIS), and amperometry i-t. The template-mediated process and the synergism between the metallic components in the electrocatalyst have provided high electroactive surface area, electrolyte diffusion, and excellent stability that promote electron transfer and enhance the response current. With a wide linear range (0.1 – 100 μM), and 24.8 nM of low detection limit (S/N = 3). The constructed non-enzymatic biosensor exhibited long-term stability and remarkable reproducibility. Furthermore, the $ZnCo_2O_4$@MOF composite-modified electrode showed an excellent anti-interference ability against the common molecules that interfere during the detection of glucose.

Introduction

Diabetes is a chronic health disorder, that is marked by the consistent inability of the body to appropriately manage the glucose level in the blood [1]. Rigorous monitoring of blood glucose levels is significant for managing diabetes and to reduce the problems associated with it. Major complications like diabetic nephropathy, diabetic retinopathy, cardiovascular diseases, stroke, and limb amputation have led to reduced life expectancy and increased morbidity [2]. The devastatingly increasing number of diabetes-related diseases in India has become a huge challenge. These problems are alarming and need to be critically addressed with a proper healthcare system and proper monitoring equipment. The socioeconomic burden on patients has caused delayed and missed diagnoses. Hence there is an urgent need to develop a reliable glucose monitoring system that is cost-effective and has high sensitivity and selectivity [3,4]. See Fig. 1.

Major technological advances and scientific innovations for developing non-invasive systems to monitor glucose have been witnessed in the last decade [5–7]. Glucose can be monitored by switching over to electrochemical sensing techniques which are painless and non-invasive by avoiding afflicting finger-pricking blood sampling techniques [8–13]. Instead, analysis is carried out by exploiting external assays of body fluids such as tears, saliva, and breath. Even though great progress has been accomplished in the field of glucose biosensing, still it suffers from serious flaws. Enzyme-based glucose sensors struggle with the problems of pH, temperature, enzyme denaturation, complex process of enzyme purification, low stability, and ionic strength. Non-enzymatic glucose sensing is of clinical and industrial relevance as it relies directly on the

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