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A Study on Glucose Sensing Using Cadmium Hydroxide Nanowires

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Abstract

Glucose monitoring is a critical aspect of medical diagnostics, particularly for the management of diabetes mellitus, a chronic metabolic disorder characterized by abnormal blood glucose levels. Continuous monitoring and precise detection of glucose levels are essential for effective disease management and prevention of complications such as cardiovascular disorders, neuropathy, and kidney damage. In recent years, nanotechnology has provided innovative pathways for developing highly sensitive, selective, and cost-effective glucose sensors. Among various nanostructured materials, cadmium hydroxide ($Cd(OH)_2$) nanowires have emerged as promising candidates for electrochemical glucose sensing due to their unique structural, electronic, and catalytic properties. Glucose sensing is broadly divided into enzymatic and non-enzymatic approaches. Enzymatic sensors, primarily based on glucose oxidase (GOx), are highly selective but often suffer from limitations such as instability under varying temperature and pH conditions, complex fabrication procedures, and short shelf life. Non-enzymatic glucose sensors, on the other hand, rely on the direct electrochemical oxidation of glucose on the surface of electrode materials, offering higher stability, reproducibility, and simplified design. The performance of non-enzymatic sensors is strongly dependent on the surface morphology, conductivity, and catalytic activity of the electrode material. Cadmium hydroxide nanowires represent a promising class of nanomaterials for non-enzymatic glucose sensing. Their high surface area, catalytic activity, and efficient electron transfer pathways contribute to high sensitivity, rapid response, and good selectivity. While challenges such as cadmium toxicity and long-term stability exist, advances in nanofabrication, surface functionalization, and hybrid material design are likely to address these issues. Continued research on $Cd(OH)_2$ nanowires and their integration into practical sensing devices could revolutionize glucose monitoring, providing reliable, cost-effective, and real-time solutions for diabetes management.

Keywords: Glucose, sensing, cadmium, nanowires