

To Whom It May Concern

February 21st, 2025

Review of PhD Thesis authored by Paltusheva Zhaniya Urazgalievna, titled "Synthesis and study of the properties of nanostructured semiconductor materials for application in sensor devices", submitted to Kazakh National Research Technical University named after K.I. Satpayev in specialty of 8D07103 - Materials Science and Engineering

The production and study of the properties of nanostructured semiconductor materials for use in sensor devices, which are the aim of the study conducted by Paltusheva Zh.U., is of considerable interest due to its potential for biomedical applications. This study has resulted in the development of cost-effective methods for synthesizing nanostructured semiconductor materials, the optimization of synthesis conditions, and an in-depth analysis of the optical and electrochemical properties of the resulting materials. Additionally, prototypes of sensors based on these materials were created.

Among these innovations is a fiber optic sensor with a thin layer of synthesized zinc oxide deposited on a spherical resonator, designed for the detection of the CD44 protein. CD44 is a well-known biomarker for cancer stem cells, playing a crucial role in regulating various signaling pathways that influence cancer proliferation, invasion, metastasis, and therapy resistance. It is also modulated by various molecules in cancer cells.

The scientific novelty of this study lies in the development of cost-effective methods for synthesizing nanostructured semiconductor materials, the investigation of their optical and electrochemical properties, and the fabrication of a fiber optic sensor incorporating a zinc oxide layer for CD44 detection. This biosensor offers several advantages, including reliability, rapid response, affordability, a low detection limit of 10 aM, a broad sensitivity range from 100 aM to 100 nM, and high biocompatibility.

Paltusheva Zh.U. has demonstrated significant achievements in producing nanostructured semiconductor materials with enhanced characteristics, such as high sensitivity, selectivity, and stability in sensor applications. A thorough analysis of the results allows us to evaluate their impact on enhancing sensor properties and to conduct a comparative analysis with existing technologies.

In completing this dissertation, Paltusheva Zh.U. has exhibited a deep understanding of the subject, a rigorous scientific approach, and a noteworthy contribution to the field of semiconductor materials technology and its application. The work is characterized by its relevance, originality, and practical significance. All tasks outlined by Paltusheva Zh.U. have been thoroughly addressed, resulting in substantial scientific findings.

The dissertation work of Paltusheva Zh.U. meets the requirements for the content and design of PhD dissertations. The volume and high level of the work allows us to consider Paltusheva Zh.U. worthy of seeking a PhD degree in the specialty 8D07103 - "Materials Science and Engineering".

Sincerely

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