VILNIUS UNIVERSITY
FACULTY OF CHEMISTRY AND GEOSCIENCES

Shandey Jose
Master in Pharmaceutical Chemistry
Master's Thesis

Investigating the Influence of Zinc Acetate Dihydrate Concentration on the Morphology of ZnO Seed Layer and ZnO Nanorods Grown by Hydrothermal Method

Scientific advisor
Prof. habil. Dr. Arunas Ramanavicius
Head of the Department of Physical Chemistry,
Faculty of Chemistry and Geosciences, Vilnius University
Consultant: Dr. Sarunas Zukauskas

Vilnius 2024

SUMMARY

VILNIUS UNIVERSITY
FACULTY OF CHEMISTRY AND GEOSCIENCES

SHANDEY JOSE

Investigating the Influence of Zinc Acetate Dihydrate Concentration on the Morphology of ZnO Seed Layer and ZnO Nanorods Grown by Hydrothermal Method.

The study effectively explored the influence of varying concentrations of zinc acetate dihydrate (ZAD) on the morphology and structural properties of ZnO nanorods synthesized via the hydrothermal method. It was observed that a ZAD concentration of 0.01 M resulted in minimal aggregation of ZnO nanoparticles, giving a more uniform seed layer deposition. In contrast, higher ZAD concentrations led to increased nanoparticle aggregation, providing comprehensive coverage of the glass substrates. Structurally, the lowest ZAD concentration produced nanorods with the highest intensity of vertical alignment, while higher concentrations resulted in nanorods with varied orientations. High ZAD concentrations were associated with sparse and uneven seed layers, sparse nanorod arrays, variable morphology, and inconsistent alignment. Conversely, low ZAD concentrations facilitated the formation of dense and uniform seed layers, dense nanorod arrays, uniform morphology, and enhanced vertical alignment. To further optimize the synthesis of high aspect ratio and density ZnO nanorods, additional studies involving optical analysis and structural analysis, such as X-ray diffraction (XRD), are necessary. These analyses will provide insights into the light absorption, emission properties, and detailed crystalline structure of the nanorods. Overall, the findings underscore the significant influence of growth temperature, precursor concentration, and deposition time on the morphology and ordering of ZnO nanorods, with low ZAD concentrations proving ideal for achieving dense, uniform, and well-aligned nanorods suitable for various applications.

ZnO (zinc oxide) nanorods are highly versatile in the medical field due to their biocompatibility, antibacterial properties, and excellent photochemical characteristics. They are used to prevent infections in medical devices and wound dressings, serve as carriers for targeted drug delivery, and are integral in biosensors for rapid diagnostic purposes. In cancer treatment, they are utilized in photodynamic therapy to kill cancer cells, and their application as contrast agents enhances imaging techniques like MRI and fluorescence imaging. ZnO nanorods also support tissue engineering by promoting cell growth and regeneration, provide antioxidant benefits for treating oxidative stress-related diseases, and exhibit antiviral properties that can aid in developing antiviral drugs and protective coatings. These diverse applications underscore their potential to significantly improve medical treatments and diagnostics.