

## PREFACE

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This book, in its fifth iteration, includes valuable contributions from experts on topics related to nanotechnology, coordinated by Dr. José Abraham Balderas López, who is a researcher at the **Instituto Politécnico Nacional** (IPN) and who has coordinated the IPN Nanoscience and Micro-Nanotechnologies Research Network (RNMN) since January of 2024.

The field of nanotechnology is becoming increasingly important due to its impact in the areas of health, food, environment, energy and semiconductors. These areas are closely aligned with several of the missions presented by the Research and Postgraduate Secretariat, through the Coordination of Operation and Research and Postgraduate Networks of the IPN, at the **2024 Polytechnic Research and Postgraduate Networks Meeting**. These ten missions that will guide the research efforts at IPN in the coming years are:

1. Sustainable agriculture and food security.
2. Biodiversity, environment and water crisis.
3. Resilience and comprehensive risk management.
4. Transition towards renewable energies and energy sustainability.
5. Epidemiological surveillance and prevention of health risks.
6. Semiconductors and advanced electronics.
7. Strategic artificial intelligence and data science program.
8. Health for the future: prevention and control of chronic diseases.
9. Industry, value chains and infrastructure.
10. Aerospace research, telecommunications and connectivity.

Thus, this book compiles current research advances aligned to five of the missions presented above, standing out the advances made by researchers who participate in the Nanoscience and Micro-Nanotechnologies Research Network and contribute to the generation of scientific knowledge and cutting-edge technological development. The missions to which a closer alignment is shown by the chapters included in this book are: *Sustainable agriculture and food security*; *Biodiversity, environment and water crisis*; *Transition towards renewable energies and energy sustainability*; *Semiconductors and advanced electronics*; as well as *Health for the future: prevention and control of chronic diseases*. As can be seen, the collaboration of members of the IPN Research Networks arises as a key factor in solving problems of regional, national, or international interest.

## LIST OF CHAPTERS BY RESEARCH AREA

### Sustainable agriculture and food security

Among the main challenges that future generations will face is the lack of food and/or spaces to grow or store it, for this reason the book includes two chapters related to these topics: “Prototype hydroponic system with LED lighting control and parameter measurement for various horticulture crops” and “Microencapsulation of Nance (*Byrsonima crassifolia* L.) extraction by spray drying”, for the production of functional foods.

The following two chapters are aligned with mission two, **biodiversity, environment and water crisis**.

“Mesoporous Silica Nanoparticles as Adsorbents of Methylene Blue Aqueous Solutions”, this work discusses the risks posed by water contaminated with methylene blue, as well as the most used methods for the removal of this dye, highlighting the adsorption method and mesoporous silica nanoparticles as adsorbents.

“Dynamic System Development for Real-Time Light Spectra Acquisition for Optical Biosensor Applications in Python”, this work presents the development of a dynamic real-time light spectrum acquisition software system utilizing Python, a high-level programming language, focusing on optical biosensor applications.

In the **transition towards renewable energies and energy sustainability**”, the following contributions are presented:

“*Bio-jet fuel* production from the enhanced crops of *Botryococcus braunii* by MgO nanoparticles (MgO NPs)”, in this work, bio-jet fuel was obtained from the lipids of the microalgae *Botryococcus braunii*, cultivated in pre-treated wastewater and adding MgO NPs to improve lipid and / or biomass production in the crop.

“TiO<sub>2</sub>-WO<sub>3</sub> Heterojunctions for Photocatalytic Hydrogen Generation”, in this research, it was synthesized TiO<sub>2</sub> nanosheets and a composite based on a TiO<sub>2</sub>-WO<sub>3</sub> heterojunction using a hydrothermal method as a clean energy for hydrogen production.

In **semiconductors and advanced electronics** you can find the chapters titled:

“Effect of Density of States in electrical simulation of amorphous Indium-Gallium-Zinc-Oxide Thin Film Transistor”, materials such as amorphous Indium-Gallium-Zinc-Oxide (a-IGZO) due to their optical transparency and low deposition temperatures are used in low-cost flexible electronics, which gives the possibility of a-IGZO TFTs in portable electronics for healthcare sensing.

“Numerical Modeling of Surface Acoustic Waves for Electronic Filter Design”, in this work, a detailed methodology for the design and numerical simulation of a surface acoustic wave bandpass filter in a 128°YX LiNbO<sub>3</sub> piezoelectric material is presented.

Finally, in “**health for the future: prevention and control of chronic diseases**”, the following research is presented:

“Silver and copper nanofluids, synthesis, characterization and their antimicrobial properties against pathogenic microorganisms”, in this work, important applications related to the antimicrobial activity of nanoparticles are explored, which is an alternative to the use of antibiotics and may be a solution to the problem of microbial resistance to the latter.

“Synthesis of new chitosan-glutaraldehyde scaffolds for Tissue Engineering using Schiff reactions”, development of suitable scaffolds for tissue engineering is still one of the most important fields in regenerative medicine.

I hope this book helps to disseminate the works of our scientists and to improve the knowledge of the subjects studied and developed in the area of nanoscience and micro-nanotechnology.

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