



Science Academies' Lecture workshop On Nanomaterials for Semiconducting Technologies



JULY 22nd to 24th, 2026

Organized by



**Indra Ganesan College of Engineering
&
Department of Research
and Development
Indra Ganesan Institutions
Tiruchirappalli, Tamil Nadu**

in association with

Indian Academy of Sciences, Bengaluru
Indian National Science Academy
The National Academy of Sciences

STUDY MATERIAL

Coordinator



Dr. M. Anusuya
Registrar, Indra Ganesan Institutions,
Professor of Department of Physics,
Indra Ganesan College of Engineering,
Tiruchirappalli, Tamil nadu

Convenor



Dr. Arindam Ghosh
Professor,
Department of Physics
IISC, Bengaluru.
Karnataka.

Title: Nanomaterials for Semiconducting Technologies

Author's Name: Dr. M. Anusuya

Published by: Shanlax Publications
61, 66 T.P.K. Main Road,
Vasantha Nagar, Madurai – 625003,
Tamil Nadu, India

Printer's Details: Shanlax Press
66 T.P.K. Main Road,
Vasantha Nagar, Madurai – 625003,
Tamil Nadu, India

Edition Details (I,II,III): I

ISBN: 978-93-6163-075-0

DOI: <https://doi.org/10.34293/shanlax.9789361630750>

Month & Year: July, 2026

Copyright @ Dr. M. Anusuya

Pages: 70

Price: ₹310/-

Disclaimer: The views, interpretations and conclusions in this book are solely those of the author(s). The author(s) assure that any use of AI tools has been limited only to improving grammar, spelling, and language quality, and not for generating substantive content. The publisher is not responsible for any plagiarism or AI-generated material that may appear in the manuscript. Although plagiarism and AI checks are performed using available tools, varying results across systems prevent absolute accuracy. All ethical and legal responsibilities for the content rest entirely with the author(s).

PREFACE

The convergence of nanotechnology and semiconductor engineering has become one of the defining scientific developments of the twenty-first century. As conventional silicon-based device scaling approaches its physical limits, nanomaterials – with their size-dependent electronic, optical, and structural properties – have emerged as essential building blocks for the next generation of electronic, optoelectronic, and energy devices.

This book has been written as a concise, self-contained introduction to nanomaterials in the context of semiconducting technologies. It begins with the foundational concepts of nanoscience and the classification of nanomaterials, proceeds through the principal synthesis routes and general applications, and then narrows its focus to semiconductor physics and the specific ways in which nanomaterials are transforming semiconductor devices. The final chapters survey advanced and emerging applications, along with the challenges that remain before these technologies reach their full potential.

The material presented here is written in the author's own words and organised for classroom and self-study use. It is intended for undergraduate and graduate students in materials science, electrical engineering, applied physics, and nanotechnology, as well as for practising engineers seeking a structured overview of the field.

Each chapter closes with a short set of review questions intended to reinforce the key concepts covered and to support use of this book in a classroom or self-study setting. Readers already familiar with basic semiconductor physics may choose to move directly to Chapter 6 onward, while readers new to nanomaterials in general are encouraged to work through the book sequentially, since later chapters build on the classification, property, and synthesis concepts introduced early on.

AUTHOR'S MESSAGE

It gives me immense pleasure to present this book, "**Nanomaterials for Semiconducting Technologies**" to students, researchers, academicians, and professionals. This book has been prepared with the objective of providing a comprehensive understanding of nanomaterials and their rapidly expanding role in modern semiconductor technologies. I sincerely hope that it will serve as a valuable resource for learning, teaching, and research in the field of nanoscience and semiconductor engineering.

First and foremost, I express my heartfelt gratitude to the **Indian Academy of Sciences, Bengaluru** for their generous support, encouragement, and funding provided for organizing the programme on "**Nanomaterials for Semiconducting Technologies**." Their commitment to promoting scientific excellence and research has been instrumental in the successful conduct of this programme and the development of this book.

I extend my sincere appreciation to the **Convenor, Dr. Arindam Ghosh, Professor, Department of Physics, Indian Institute of Science (IISc), Bengaluru**, for his inspiring leadership, constant encouragement, and valuable academic guidance throughout the programme. His expertise and unwavering support significantly contributed to its success.

I also express my profound gratitude to the management of **Indra Ganesan Institution** for their continuous encouragement and institutional support. My sincere thanks are due to **Er. G. Rajasekaran, Secretary, Indra Ganesan Institution**, for his visionary leadership and unwavering encouragement towards academic excellence and research activities. I am equally grateful to **Dr. G. Balakrishnan, Director, Indra Ganesan Institution**, for his constant motivation, administrative support, and valuable guidance in successfully organizing this programme.

Special Thanks to the resource persons from the various Institutions like NPL -New Delhi , GEM IT - New Delhi, NIT - Puducherry, NIT - Trichy, GCE - Trichy and BDU - Trichy.

I would like to place on record my sincere appreciation to the dedicated organizing and supporting team whose wholehearted efforts ensured the smooth execution of the programme and the preparation of this book. My heartfelt thanks go to **`Dr. M. Joseph Salethraj, Dr. R. Bharath Kumar, Ms. T. Pavithra, and Dr. B. Varalakshmi** for their commitment, cooperation, and tireless support throughout every stage of this endeavour.

My special appreciation goes to the enthusiastic **student volunteers of Indra Ganesan Institution**, whose energy, discipline, and sincere involvement played a significant role in the successful organization of the programme. Their dedication and willingness to contribute exemplify the spirit of teamwork and academic excellence.

Finally, I thank all the contributors, faculty members, participants, reviewers, and well-wishers whose encouragement and constructive suggestions have enriched this work. Above all, I thank the Almighty for His abundant blessings and guidance throughout this journey.

I sincerely hope that this book inspires readers to explore the fascinating world of nanomaterials and motivates them to contribute to the advancement of semiconducting technologies for the benefit of science and society.

Dr. M. Anusuya
Author

CONTENTS

Chapter No.	Title	Page No.
1	Introduction to Nanotechnology and Nanomaterials	1
2	Types and Classification of Nanomaterials	5
3	Properties of Nanomaterials	8
4	Synthesis Methods of Nanomaterials	11
5	Characterization Techniques for Nanomaterials	16
6	General Applications of Nanomaterials	20
7	Semiconductors: Fundamentals and Types	22
8	Nanomaterials in Semiconductor Technology	28
9	Advanced Applications of Nanomaterials in Semiconducting Technologies	33
10	Scaling, Trends, and Device Performance	39
11	Nanosemiconductors: Materials, Physics, And Devices	42
12	Challenges, Safety, And Future Outlook	54
13	Conclusion	56
14	References Appendix A. Glossary of Key Terms Appendix B. List of Figures and Tables	57