

ISBN: 978-93-88901-83-3

RESEARCH TRENDS IN MATERIAL SCIENCE

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BHUMI PUBLISHING, INDIA



FIRST EDITION: SEPTEMBER 2023

First Edition: September, 2023

ISBN: 978-93-88901-83-3



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Published by:

Bhumi Publishing,

Nigave Khalasa, Kolhapur 416207, Maharashtra, India

Website: www.bhumipublishing.com

E-mail: bhumipublishing@gmail.com

Book Available online at:

<https://www.bhumipublishing.com/book/>

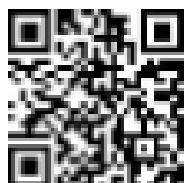


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RECENT ADVANCEMENTS IN METAMATERIALS

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Abstract:

This chapter presents a comprehensive review of the latest breakthroughs in metamaterial science and technology. We explore developments in various metamaterial applications, including invisibility cloaks, super lenses, acoustic manipulation, and quantum metamaterials. Additionally, we delve into emerging frontiers such as topological metamaterials and smart, adaptive structures. This chapter addresses the key challenges of metamaterial manufacturing, efficiency optimization, and integration into real-world systems. The implications of these advancements are far-reaching, offering prospects for revolutionizing fields ranging from telecommunications and quantum computing to energy efficiency and healthcare. In addition to this chapter highlights the remarkable progress in metamaterials and underscores their transformative potential in shaping the technological landscape of the future.

Keywords: Metamaterials; Negative Refractive index; Acoustic Metamaterials

Introduction:

Metamaterials represent a groundbreaking and interdisciplinary field of materials science that has gained immense attention and significance in recent years. These synthetic materials are meticulously engineered at the nanoscale to possess unique properties and capabilities that defy the natural constraints of conventional materials. Metamaterials owe their name to their inherent ability to manipulate and metamorphose the behaviour of waves, be they electromagnetic, acoustic, or thermal, in ways that were once considered purely theoretical. The concept of metamaterials originated from the pursuit of extending the boundaries of material science, particularly in the domain of wave manipulation. This innovative approach capitalizes on the idea that by structuring materials at scales much smaller than the wavelength of the waves they interact with, we can control and tailor their properties with unparalleled precision. One of the most striking features of metamaterials is their ability to achieve a negative refractive index. Unlike natural materials, which always refract light or other waves in a positive direction, metamaterials can bend waves in a

Research Trends in Material Sciences (ISBN: 978-93-88901-83-3)

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Dr. Aloke Verma is the Head of the Physics Department at Kalinga University, Naya Raipur (CG). He has over 13 years of excellent teaching and academic experience. He earned his PhD in Physics. He has over 40 research papers, four books, and seven book chapters published in national and international journals. In national and international conferences and seminars, he has presented over 50 research papers. He has attended over 100 workshops, FDPs, and webinars. Several students successfully completed dissertation work under the supervision of Verma. He has received numerous teaching and academic awards.



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