Engineering Materials

Arnold C. Alguno · Rey Y. Capangpangan · Gerard G. Dumancas · Arnold A. Lubguban · Roberto M. Malaluan · Rolen Brian P. Rivera

Metal Nanoparticles-Based Nanoplatforms for Colorimetric Sensing

Mechanisms, Applications, and Future Directions

Springer

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Preface

The effectiveness of nanotechnology represents a paradigm shift in analytical chemistry, combining accuracy, simplicity, and high sensitivity as a solution to the greatest challenges in environmental monitoring, food safety, and medical diagnostics. This book, *Metal Nanoparticles-Based Nanoplatforms for Colorimetric Sensing: Mechanisms, Applications, and Future Directions*, compiles pioneering research and innovation in this rapidly evolving field. This review highlights the excellent properties of metal nanoparticles (MNPs) such as gold, silver, and copper, in forming nanoplatforms that exploit their optical and catalytic properties for highly sensitive colorimetric detection.

The effectiveness of metal nanoparticles is partly attributed to their ability to exhibit localized surface plasmon resonance, which produces visible color changes indicating molecular interactions in solution. This deceptively simple yet scientifically rich observation has led to rapid advances in the detection of a wide variety of analytes, from toxic heavy metals to clinically important biomarkers. By leveraging these properties, the research community has developed durable and easy-to-use sensing devices that enable real-time diagnostics on-site that would otherwise be difficult to achieve.

Theoretical concepts, experimental methodologies, and practical applications are consolidated in this book, making it a significant reference for scientists, engineers, and technologists. The chapters carefully examine the complex properties of metal nanoparticles, explore their cooperative effects in hybrid nanostructures, and address critical such as reproducibility, cost efficiency, and scalability. The book also discusses the future perspectives, including the integration of artificial intelligence and sustainable synthesis methods that are poised to reshape nanotechnology in the years ahead.

In tribute to this collaborative endeavor of scientific creativity, the current work encourages researchers to harness the capabilities of MNPs for colorimetric sensing, fostering innovations that promote sustainability, public health, and environmental

stewardship. Readers are invited to explore this dynamic field of nanoscience, where discovery meets application and challenges evolve into opportunities.

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