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General Overview of Nanoparticles

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Abstract

Nanoparticles, a cornerstone of nanotechnology, exhibit unique physical, chemical, and biological properties that distinguish them from bulk materials. These exceptional characteristics have driven groundbreaking advancements across various fields, particularly in healthcare and electronics. This lecture provides a comprehensive overview of key nanoparticle types, their distinctive properties, and their diverse applications. At the forefront of modern innovation, nanotechnology enables precise manipulation of matter at the nanoscale, revolutionizing medicine and electronics. Nanoparticles play a pivotal role in nanomedicine—an interdisciplinary field integrating nanotechnology with biomaterials science, molecular biology, and clinical applications. For example, their unique attributes, such as superparamagnetic and semiconducting behaviour, make them invaluable for medical applications, including disease diagnosis and targeted therapy. This presentation explores the transformative potential of nanoparticle-based strategies, with a particular focus on their applications in cancer research. It will examine two key aspects: (1) the fundamental semiconducting and superparamagnetic properties of nanoparticles and (2) their role in cancer research, demonstrating how these properties enable precise, efficient, and minimally invasive treatments.

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Biography of the presenting author

Prof. Michael Giersig is a Full Professor at the Institute of Fundamental Technological Research, Polish Academy of Sciences in Warsaw, where he leads the Department of Theory of Continuous Media and Nanostructures. He also holds a professorship at the Institute of Experimental Physics at Freie Universität Berlin. Throughout his career, Giersig has dedicated himself to exploring advanced nanomaterials and nanostructures. However, he considers his most impactful contributions to be in the synthesis of nanoparticles and their applications in electronics and biomedicine. His research focuses on developing novel chemical and physical synthesis methods, uncovering unique structural and electronic properties that drive innovations in healthcare and energy. Giersig has authored over 315 internationally peer-reviewed publications spanning multiple disciplines, including physics, chemistry, materials science, biochemistry, medicine, nanotechnology, and engineering. His work has been cited over 25,400 times (ISI Index, excluding self-citations), with an h-index of 81 and an average of 82.74 citations per publication. In 2024, he was recognized among the top 2% of scientists globally in the Scientific Index.