

## Chapter 20

### Nanotechnology in Advanced Materials and Bioenergy Systems: A Green Perspective

**Nalini Ramachandran U<sup>1</sup>, R. Surendran<sup>2</sup>, S. Arunkumar<sup>3</sup>, Jagadeesh P<sup>4</sup>**

<sup>1</sup>Assistant Professor, Department of Applied Sciences, Chemistry Section University of Technology and Applied Sciences Muscat, Sultanate of Oman, naliniuthaman@gmail.com

<sup>2</sup>Assistant Professor, Department of Mechanical Engineering, K. S. R. College of Engineering, Tiruchengode, surenbe@gmail.com

<sup>3</sup>Assistant Professor, Department of Mechanical Engineering, Vels Institute of Science, Technology & Advanced Studies, Chennai 600117, Tamil Nadu, India, gct.arunkumar@gmail.com

<sup>4</sup>Assistant Professor, Department of Mechanical Engineering, K. S. R. College of Engineering, Tiruchengode, pvjagadeesh88@gmail.com

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**Abstract**

The convergence of nanotechnology with sustainable materials science and bioenergy systems represents a paradigmatic shift toward environmentally conscious technological development. This chapter explores the transformative potential of nanoscale engineering in creating advanced materials and bioenergy solutions that address contemporary environmental challenges while promoting sustainable development. Through comprehensive analysis of current research and applications, this chapter examines three critical domains: sustainable nanomaterials development, nanotechnology integration in renewable energy systems, and nanoscale solutions for bioenergy production. Key findings indicate that nanomaterials can significantly enhance solar cell efficiency by up to 40%, improve battery storage capacity by 300%, and increase

