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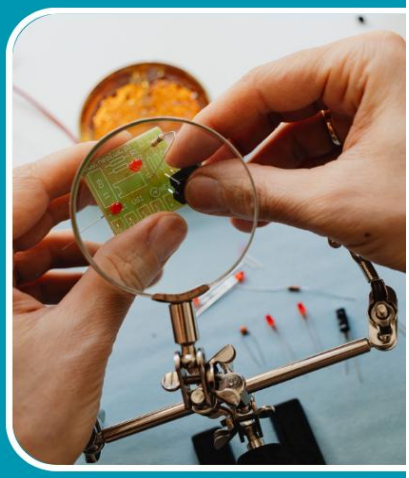
FRONTIERS IN MATERIAL SCIENCE AND NANOTECHNOLOGY

ISSN: (3065- 4114)



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Eco-Friendly Nanomaterials: A Path Toward a More Sustainable Future?

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Article Info

Received: 27-12-2024 ***Revised:24-01-2025*** ***Accepted:09-02-2025*** ***Published:22-02-2025***

Abstract

There have been tremendous breakthroughs in nanoscience in the last few years, impacting many different fields, including as biology, chemistry, materials science, physics, and medicine [1]. Many of these nanomaterials are now commercially available (e.g., silica nanowires, silicon wafers, carbon nanotubes, graphene, and derivatives), but they are still mostly associated with laboratory practices and not entrepreneurial activities. Nonetheless, they have enabled tremendous advances in the preparation of functional nanomaterials for a variety of applications [1,2].

Introduction

Concerns about the environment and sustainability have been minimally addressed in the present synthetic protocols for the fabrication of nanoentities, and there is a lack of adequate development in nanosafety procedures with regard to toxicity, handling of nanomaterials, and their environmental impact. Some of these nanomaterials can be synthesized at high temperatures and pressures using potentially harmful reagents and solvents, and there aren't always enough details about environmental factors like toxicity, handling risks, environmental impact, and green metrics included in the protocols. There are a growing number of regulations, protocols, and safety measures in place in various workplaces and labs that deal with nanomaterials on a regular basis due to the fact that these entities have fundamentally different nature and characteristics, which are frequently unknown [3,4]. Understanding and establishing the most appropriate working procedures for nanotechnologies requires a comprehensive collection of fresh and updated knowledge on traits and qualities, as well as dangers and toxicity concerns in manipulating them. But all things nano-related should adhere to the benign by design principle, with the end goal of creating eco-friendly nanomaterials and sustainable nanoprotocols in the future [5,6].

Environmentally friendly procedures for the production of nanomaterials should be included in more meticulous and well-planned design processes, as argued for in this editorial contribution. To analyze and consider the toxicity, risks, and environmental impact of the synthesis, handling, and utilization of nanomaterials in our daily practices, we should use solvent-free protocols, avoid hazardous chemicals, and use low temperature ambient pressure methods. Other greener technologies include mechanochemistry, ball milling, microwave irradiation, and sonication. Life cycle and risk assessments should be done whenever possible and appropriate. In view of the future implementation of nanotechnologies in our society, we should also consider these factors.

Based on recent advancements in the field, the author is particularly hopeful that within the next 30 years we will see a more sustainable and economically competitive society, which includes the era of environmentally compatible nanomaterials for future sustainable applications.

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trio of nanosafety clusters

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