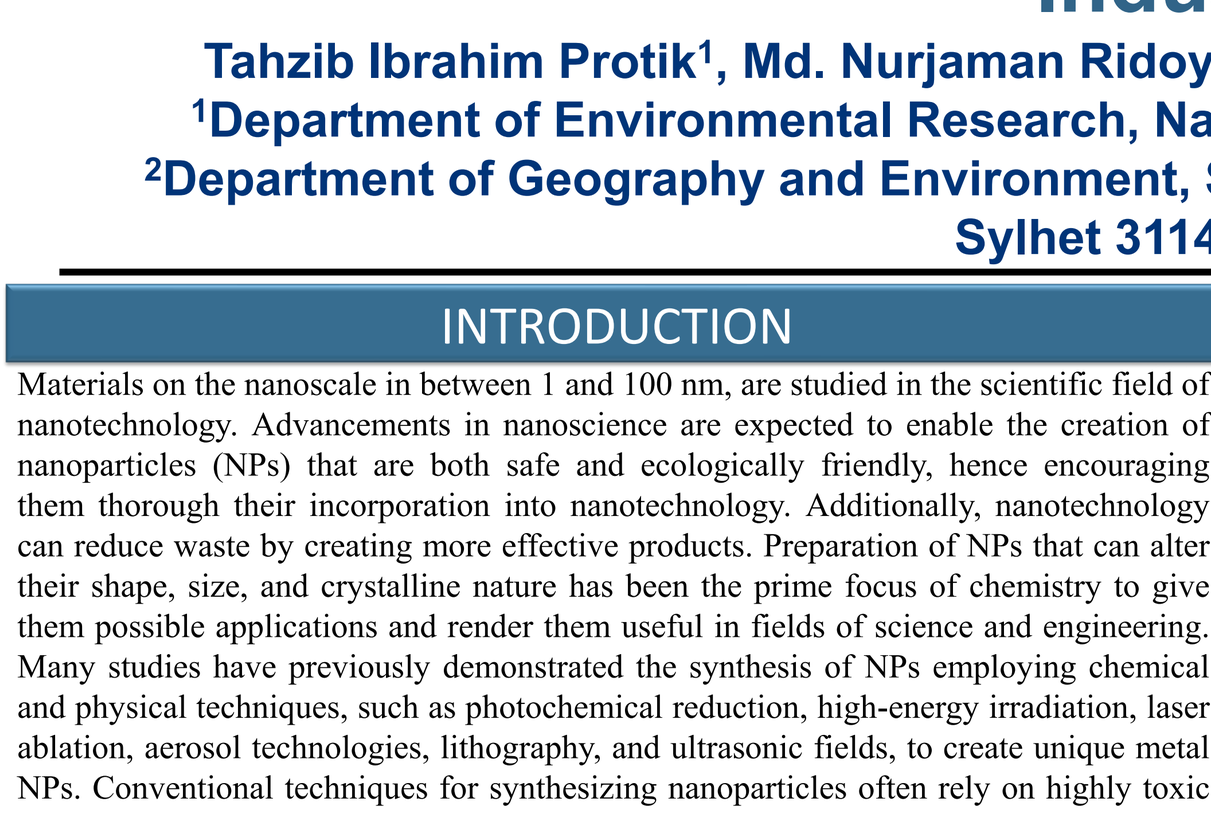
IOCN 2025 Conference
The 5th International Online Conference on Nanomaterials
22–24 September 2025 | Online
MDPI

Advances of Green Synthesized Nanomaterials in Different Industries

Tahzib Ibrahim Protik[1], Md. Nurjaman Ridoy[1], Md. Golam Sazid[1],Sk. Tanjim Jaman Supto[2]
[1]Department of Environmental Research, Nano Research Centre, Sylhet 3114, Bangladesh
[2]Department of Geography and Environment, Shahjalal University of Science and Technology, Sylhet 3114, Bangladesh

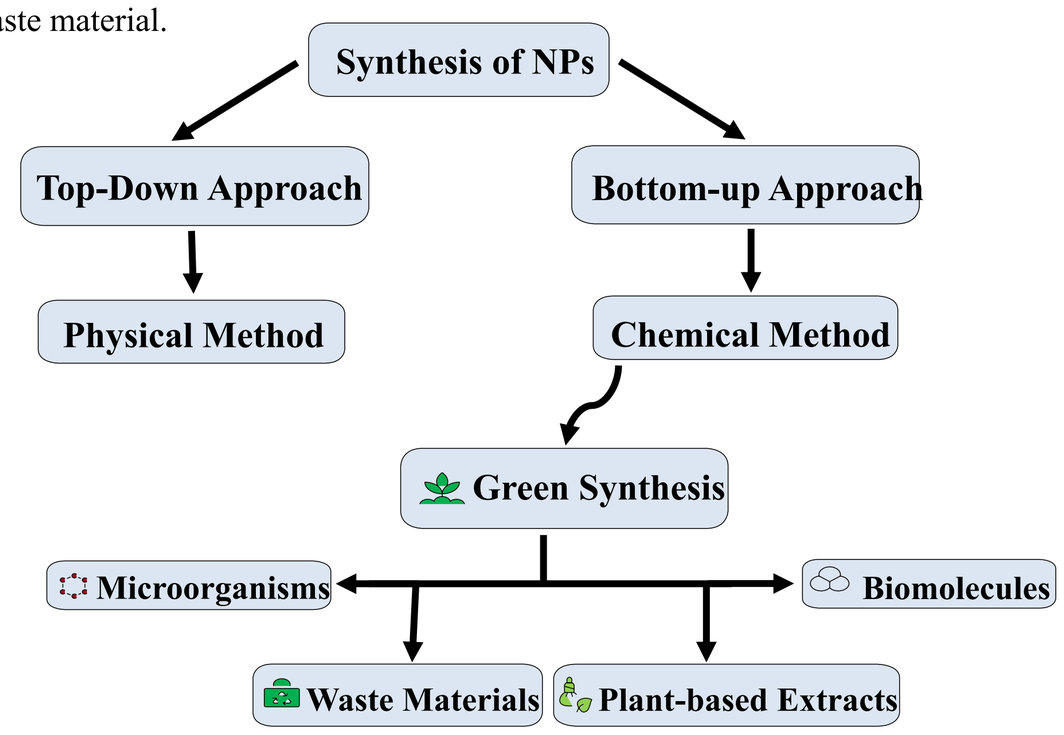
INTRODUCTION

Materials on the nanoscale in between 1 and 100 nm, are studied in the scientific field of nanotechnology. Advancements in nanoscience are expected to enable the creation of nanoparticles (NPs) that are both safe and ecologically friendly, hence encouraging them thorough their incorporation into nanotechnology. Additionally, nanotechnology can reduce waste by creating more effective products. Preparation of NPs that can alter their shape, size, and crystalline nature has been the prime focus of chemistry to give them possible applications and render them useful in fields of science and engineering. Many studies have previously demonstrated the synthesis of NPs employing chemical and physical techniques, such as photochemical reduction, high-energy irradiation, laser ablation, aerosol technologies, lithography, and ultrasonic fields, to create unique metal NPs. Conventional techniques for synthesizing nanoparticles often rely on highly toxic chemicals and generate devastating byproducts. In contrast, utilizing green sources for nanoparticle synthesis offers a safer alternative by eliminating hazardous byproducts and avoiding the use of harmful substances. The introduction of green chemistry concepts is a key method to encourage the development of sustainable urban areas.

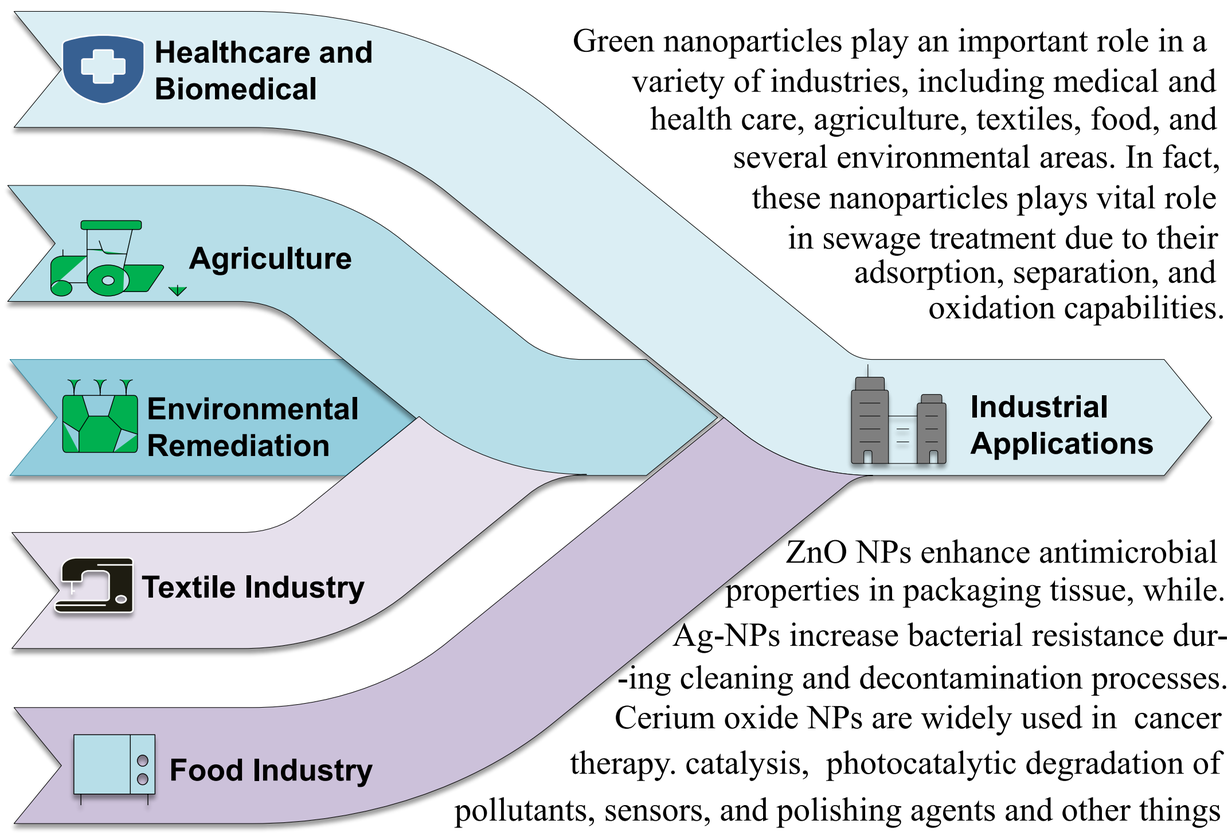


GREEN SYNTHESIS METHODS

Nanomaterials can be produced via physical methods, a top-down approach, and chemical methods, which is a bottom-up approach; one part of this approach involves biological methods. The conventional methods for the synthesis of nanomaterials are expensive, require skilled operators, and lack consideration of fundamental mechanisms and modelling factors, resulting in nanomaterials that are not stable in hostile environments and can exhibit bio accumulative or toxic features, thereby being environmentally unsustainable. Green synthesis has gained attraction over the last few years in the current research and development of nanomaterials. These methods cover green synthesized sources like Plant-based extracts, microorganisms, biomolecules, and Waste material.



APPLICATIONS ACROSS INDUSTRIES



Green nanoparticles play an important role in a variety of industries, including medical and health care, agriculture, textiles, food, and several environmental areas. In fact, these nanoparticles plays vital role in sewage treatment due to their adsorption, separation, and oxidation capabilities.

ZnO NPs enhance antimicrobial properties in packaging tissue, while. Ag-NPs increase bacterial resistance dur--ing cleaning and decontamination processes. Cerium oxide NPs are widely used in cancer therapy. catalysis, photocatalytic degradation of pollutants, sensors, and polishing agents and other things

APPLICATIONS OF GREEN SYNTHESIZED NPS

Nps	Size(nm)	Source	Effective against	Application
Ag	20–25	*Phyllanthus emblica* extract	Escherichia Coli	Antibacterial textiles, Pollutant degradation, and Antibacterial textiles.
ZnO	~20	*Acalypha indica leaf* extract	S. aureus, E. coli	Antibacterial textiles, and UV protection
CuO	~83.23	*Ruellia tuberosa* root extract	K. pneumoniae, E. coli, and S. aureus	Dye degradation, and Antibacterial textiles
ZnO	10–45	*Aspergillus terreus*	Bacteria	Safe cytotoxicity
CeO	10-125	*Abelmoschus esculentus*	HeLa Cells	Effective against cervical cancer
CuO	35.80	*Punica granatum*	E. coli	Pathogenic bacterial strain killing
TiO_2	7	watermelon peel	MCF7 cell	Anticancer activity against MCF7 cell
ZnO	3.62	*Melia azedarach* leaf extract	S. aureus	Antibacterial activity
TiO_2	17.30	orange peel	S. aureus, E. coli, and P. aeruginosa	Antibacterial activity

CONCLUSION

Green synthesized nanomaterials offer an extremely resilient, flexible and highly efficient solution for industrial usage as Nanotechnology reduces waste through improved products and avoid producing hazardous by-products. Green synthesis offers a safer alternative, avoiding hazardous substances and promoting sustainable urban development.

REFERENCES

Bahrulolum, H.; Nooraei, S.; Javanshir, N.; Tarrahimofrad, H.; Mirbagheri, V.S.; Easton, A.J.; Ahmadian, G. Green Synthesis of Metal Nanoparticles Using Microorganisms and Their Application in the Agrifood Sector. *J Nanobiotechnol* **2021**, *19*, 86, doi:10.1186/s12951-021-00834-3.

Lu, Y.; Ozcan, S. Green Nanomaterials: On Track for a Sustainable Future. *Nano Today* **2015**, *10*, 417–420, doi:10.1016/j.nantod.2015.04.010.

Gour, A.; Jain, N.K. Advances in Green Synthesis of Nanoparticles. *Artificial Cells, Nanomedicine, and Biotechnology* **2019**, *47*, 844–851, doi:10.1080/21691401.2019.1577878.