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Letter to the Editor Open Access

Potential Biotechnological Applications of Nano-Immobilized Biocatalysts in Bioenergy Production

Madan L Verma*

Department of Biotechnology, School of Basic Sciences, Indian Institute of Information Technology Una, Himachal Pradesh, India

Letter to the Editor

Developing highly efficient biocatalyst is a pertinent requirement for biofuels production, in particularly biodiesel/bioethanol. To circumvent the minimal efficiency of conventionally used biocatalysts, nanotechnology paves a way by indulging nanoparticles as carriers of biocatalysts. The nano biocatalysts so formed are applied as a tool for utilizing wide set of biomass related molecules into biofuels. The disadvantages of conventional biocatalysts such as catalyst deactivation, mass transfer, poisoning and long reaction time can be outstripped by novel nano biocatalysts [1].

Nano biocatalyst enhances catalytic activity, which is due to the increased surface to volume ratio, and hence it can also operate as a deoxygenation catalyst. In recent years, utilizing current methods for nanoparticle synthesis has become more common. Nanocatalysts enable quick and specialized reactions while also facilitating the recycling process. Alkaline earth metal oxides (CaO, MgO), transition metal oxides (Nano-sulfated TiO_2), mixed metal oxides (TiO_2-ZnO, Iron-Cadmium, Iron-Tin) and supported metal oxide nanocatalysts [2].

The importance of nanomaterials such as carbon, fullerene, TiO_2, SnO_2, graphene, Fe_3O_4, and ZnO in creating biofuels is increased by the most frequent characteristic features and special properties of nanocatalysts such as high selectivity, activity, stability, ease of separation and energy efficiency. The conversion efficiency of biomass is improved by other qualities such as the types of metal nanoparticles used, the porous nature of the material and the changeable acid base property. Surface material, size and shape all have a significant impact on nano catalytic characteristics. Catalysts with smaller particle sizes have more surface area, which means more active catalytic sites are available. The catalytic activity is influenced by changing particle morphologies to cubic, spherical and tetrahedral. Modifying the chemical composition on the surface of catalysts can improve selectivity [3-5].

An expanding study topic is the use of green and environmentally friendly technologies to solve the limitations associated with physical and chemical methods of nanomaterials fabrication. Green synthesis is another bottom-up strategy that could provide a more straightforward, cost-effective and environmentally friendly way to make nanomaterials. A lot of effort has gone into developing biosynthetic inorganic materials that use microorganisms as eco-friendly nanofactories for this purpose. By virtue of their simple assembly, bacteria, fungus, yeast and actinomycetes had received the most interest among microorganisms. Other biological agents, such as algae and protists, have also gotten a lot of attention for nanomaterial creation.

Prokaryotic bacteria (e.g. S-layer bacteria) are examples of well-known microorganisms that synthesize inorganic compounds either intracellularly or extracellularly (that produce gypsum and calcium carbonate layers) magnetotactic bacteria synthesize magnetite nanoparticles, diatoms synthesize siliceous materials, and eukaryotic organisms synthesize eukaryotic organisms synthesize eukaryotic organisms synthesize eukaryotic organisms synthesize eukaryotic organisms synthesize eukaryotic organisms synthesize the nature of biological entities, pH, temperature, reaction time, agitation and other parameters all influence the size and shape of nanomaterials produced. Green nanomaterials can be biosynthesized by microbes *in vivo* or *in vitro*, with cofactors acting as stabilizing or capping agents.

Because of these difficulties, characterization of nanoparticles frequently necessitates the application of a diverse set of methodologies. Characterization methods can be broadly classified into morphological, optical, structural and magnetic characterization based on the specific parameter of nanomaterials to be researched. UV-visible spectroscopy, dynamic light scattering, energy dispersive spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy, X-ray photo-electron spectroscopy and Raman spectroscopy are some of the spectroscopic and diffractographic techniques used to characterize nanomaterials. These approaches are used to investigate the composition, structure and crystal phase of nanomaterials, either individually or in combination. Scanning electron microscopy, transmission electron microscopy, high resolution transmission electron microscopy and polarized optical microscopy are examples of advanced microscopic techniques.

Conclusion

The use of nanocatalysts to convert renewable biomass to biofuel is a cost-effective alternative to currently available expensive technologies and the use of nanotechnology to speed up the conversion process is also environmentally benign. Nanocatalysts have been shown to have higher catalytic conversion efficiency, selectivity, ease of operation, economic viability and long-term efficiency. When creating a nanomaterial immobilized enzyme for biofuel use, consider operational procedures, durability, feedstock needs and commercialization prospects. Durability is a need in industrial applications.

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***Corresponding author:** Madan L Verma, Department of Biotechnology, Indian Institute of Information Technology Una, Himachal Pradesh, India; E-mail: madan864@gmail.com

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Conflict of Interest

The authors declare that they are no conflict of interest.

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