Editorial

Smart Bio-palladium nano materials synthesis by green method

Abstract

Smart palladium nanoparticles (PdNPs) are of special interest due to their distinctive characteristics and a large unfold of applications. PdNPs are synthesized by the conventional physical and chemical methods. These methods have several drawbacks and thus, biological methods are found to be substitute to the conventional methods. Biological method may be an easy, reliable, non-toxic and eco-friendly for synthesis of smart nanomaterials. Bacterial cells and plant materials are widely used as potential reducing agents for PdNPs synthesis. However, molecular mechanisms concerned in PdNPs synthesis don't seem to be well understood and special efforts are needed more.

Keywords: Palladium nanoparticles, Eco-friendly, Plant, Microorganisms, Nanomaterials

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Bankar Ashok V
Department of Microbiology, Savitribai Phule Pune University, India

Correspondence: Bankar Ashok V, Department of Microbiology, WCS, Savitribai Phule Pune University, Pune, Maharashtra, India Email ashok@unipune.ac.in

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Editorial

Nobel metallic nanomaterials like palladium nanoparticles (PdNPs) are gaining a special attention from scientific community owing to their distinctive physical, chemical and optical properties.[1] Such smart Pd nanomaterials are use in surface-enhanced Raman scattering, catalysis, fuel cells, hydrogen storage, chemical/biological sensing, plasmonic wave guiding, drug delivery, magnetic recordings, chemo-optical transducers, environmental protection and cancer therapy.[2,3] The conventional physical and chemical methods like sol-gel synthesis, aerosol technology, lithography, laser ablation, chemical reduction, electrochemical and polyol etc. are employed for nanomaterials synthesis. These methods require expensive chemicals and high consumption of energy underneath extreme conditions. The hazardous chemicals like organic solvents, reducing agents and stabilizers are getting used for nanoparticles synthesis and to forestall agglomeration of colloids. The formation of smart nanomaterials along with deadly chemicals is preventing their clinical and biomedical applications.[4,5] A continual effort is needed for developing easy, clean, reliable, biological compatible and eco-friendly methodology for smart nanomaterials synthesis.[6]

Biological approach could be an inexperienced, eco-friendly, non-toxic and efficient and a suitable substitute to the conventional methods for nanomaterials synthesis. Biological systems like bacteria, fungi, algae and plant materials.[7-9] are being used for nanomaterials synthesis. The knowledge base approach between microbiology and material science offers a breathtaking prospect for several researchers to urge engaging nanomaterials. Interestingly, a bacterial system is one in every of the reducing agents for inorganic nanoparticles synthesis. A bacterial system may be a promising "micro-factory" to allow high yields of smart nanomaterials. Bacterial cells have some helpful options as follows:

They're long within the atmosphere

a. Adapt simply to extreme conditions

b. Quick-growing

c. Cheap to cultivate and

d. Easy to manipulate.

The metal-reducing bacteria became a special attraction in recent years because of their ability for electricity generation and wastes removal. Bacterial system intercede nanoparticles are rapidly developing research area in a green nanotechnology.[10,11] Bacterial cells like *Pseudomonas*, *Escherichia coli*, *Desulfovibrio desulfuricans*, *Shewanella oneidensis*, *Clostridium butyricum*, *Citrobacter braakii*, *Enterococcus faecium*, *Bacteroides vulgates, Bacillus sphaericus* and *Geobacter sulfurreducens.*[12-16] are well studied 'green materials' for PdNPs synthesis. The formation of PdNPs by *D. desulfuricans* was probably due to the enzyme hydrogenlyase.[14] *S. oneidensis* cells are used for bio-PdNPs and bio-Pd/Au NPs synthesis and employed in dechlorination of pollutants.[15,17] Cr (VI) is one of the toxic metals widely used in leather industries and incessantly discharges into wastewater.[18] Cr (VI) metal ions are reduced by PdNPs prepared from plant *G. sulfurreducens.*[19] Metallic Pd and Pd-AuNPs were synthesized under ambient conditions with *S. oneidensis*. These nanocomposites have demonstrated excellent catalytic activities for reduction of various nitroarenes.[20] Au-rich core and Pd-rich shell type nanomaterials formed by *E. Coli* cells are used as catalysts for the oxidation of benzyl alcohol.[21] PdNPs formed by bacteria like *G. sulfurreducens* and *E. Coli* are employed in a variety of chemical reactions including Heck couplings .[22,23]

Plant material is another excellent 'green source' for PdNPs synthesis in green nanotechnology. Therefore, the biological approach for nanomaterials synthesis by using plant materials is a good substitute to the conventional chemical methods. Plants mediate nanoparticles synthesis technique is quicker, more economical, efficient and simple to rescale in massive quantities.[24] Plant extracts are useful 'green material' as result of they contain each reducing and stabilising agents for nanoparticles formation.[25] Therefore, a range of plant extracts of *Cinnamon zeylanicum* bark, *Annona squamosa* peel, *Coffea arabica*, *Camellia sinensis*, *Gardenia jasminoides*, *Curcuma longa* tuber, *Gardenia jasminoides* leaf, *Glycine max* leaf, *Cinnamomum Camphora* leaf, *Asparagus racemosus* root and banana peel are used for PdNPs synthesis of different size and shape.[7,25-30] Bio-PdNPs formed by living plants, *Colocasia esculentaleaf*and *Euphorbia granulate*extract are employed in a variety of Suzuki-Miyaura coupling reactions .[31-33] Similarly, PdNPs synthesised by an aqueous solution of *Pulicaria glutinosa* and watermelon rind have incontestible a wonderful catalysts for the Suzuki coupling reaction.[34,35] Bio-PdNPs synthesized by *Delonix regia* leaf extract have also demonstrated a catalytic activity for nitro-aromatic hydrogenation.[36] Green synthesis of PdNPs by employing a gum ghatti (*Anogeissus latifolia*) showed a superior antioxidant property even at lower concentration. They even have demonstrated a catalytic activity for reduction of dyes like methyl orange, methylene blue, coomassie brilliant blue G-250 and 4-nitrophenol with sodium borohydride .[37] PdNPs produced by Xanthan gum showed a catalytic activity towards the reduction of 4-nitrophenol to 4-aminophenol.[38] The biogenic PdNPs formed by using leaf aqueous extract of *Eclipta prostrate have demonstrated the antiplasmodial activity against Plasmodium berghei* in Swiss albino mice.[39] PdNPs synthesized by *Azadirachta indica* extract used as catalysts within the formation of imine derivatives without any surface change.[40] Thus, bio-Pd nanoparticles are synthesized by green materials having a variety of applications. Bacterial cells and plant materials are widely studied 'green sources' for PdNPs synthesis. Other green sources like yeasts, fungi, algae and viruses are needed to be explored for PdNPs synthesis in future. The main points of molecular mechanisms concerned in metal nanoparticles synthesis aren't nonetheless alright and more research work needed further.[41]

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Conflicts of interest

None.

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