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Facile one-pot synthesis of crystalline palladium nanoparticles with exceptional catalytic and antiradical activities

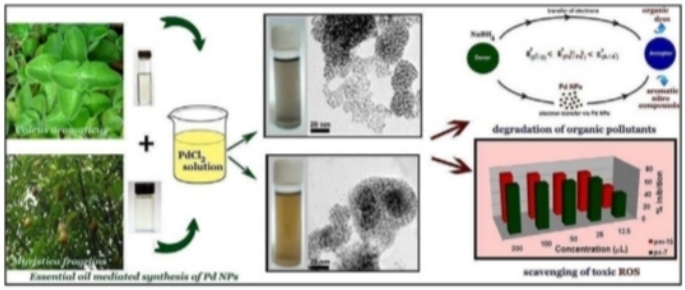
Vidya Vilas [a, b], Daizy Philip [a, *], Joseph Mathew [b]

[a] Department of Physics, Mar Ivanios College, Thiruvananthapuram, 695015, India
[b] Department of Chemistry, Mar Ivanios College, Thiruvananthapuram, 695015, India

HIGHLIGHTS

- Pd nanoparticles are synthesized using essential oil for the first time.
- Terpenoids and phenolic derivatives reduce Pd^{2+} to Pd^0.
- Clusters of 2–3 nm sized Pd nanospheroids are formed.
- Pd nanocatalysts efficiently degrade organic dyes and aromatic nitro compounds.
- Biogenic Pd nanoparticles exhibit reducing power and antiradical activities.

GRAPHICAL ABSTRACT



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ABSTRACT

It is for the first time that the essential oils of medicinal plants are used for the synthesis of palladium nanoparticles, one of the rarest and precious transition metals known to mankind. In the present study, leaf essential oil of *Coleus aromaticus* and *Myristica fragrans* is used as the bioreductant. The appearance of an absorption continuum in the UV–vis spectrum indicates the formation of palladium nanoparticles. The effect of varying quantities of biomaterial on the synthesis of nanopalladium is studied. TEM micrographs disclose the formation of clusters of well dispersed nanospheroids of size ~2.8 nm. Sharp peaks in the XRD are indexed to Bragg reflections from planes corresponding to face centred cubic crystalline structure. FTIR spectral analyses reveal the participation of terpenoids and phenolic ether derivatives in reduction and capping. The synthesized nanoparticles exhibit significantly high catalytic efficiency in degrading a broad spectrum of organic pollutants including methyl red, methyl orange, eriochrome black T, methylene blue, rhodamine B, ortho-, meta- and para-nitrophenols. The reduction reactions are observed to obey pseudo first order kinetics. Antioxidant potential of the as synthesized palladium nanoparticles is portrayed through DPPH assay, nitric oxide and hydroxyl radical scavenging activities and reducing power activity.

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1. Introduction

Over the years, phytosynthesis of precious metallic nanoparticles (NPs) has remained as one of the potential areas of research throughout the world, owing to the eco benign nature of the protocol that restrains from the use of toxic chemicals and aggressive energy conditions. The unique physio-chemical, electronic and magnetic properties of bioinspired metallic NPs have led to their extensive applications in catalysis, electronics, medicine,

* Corresponding author.
E-mail addresses: daizyp@rediffmail.com, philipdaizy@yahoo.co.in (D. Philip).

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