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Research Article

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# Structural, Morphological and Optical Properties: CeO<sub>2</sub> Nanoparticles Prepared through the *Azadirachta indica* Leaf Extract by Green Method

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**ABSTRACT** Font: Roboto Slab Size: 10 pt Align: left After space: 10pt

The CeO<sub>2</sub> NPs were derived from *Azadirachta indica* (A.indica) leaf extracts. The X-ray diffraction studies confirmed that synthesized CeO<sub>2</sub> NPs were exhibited the cubic structure. In XPS spectra, the oxidation states of each element were identified for CeO<sub>2</sub> NPs. The Raman active mode was observed at 461cm<sup>-1</sup>, and this was due to the symmetrical stretching mode of the Ce-8O for CeO<sub>2</sub> NPs. From FESEM and TEM images, the CeO<sub>2</sub> NPs were exhibited a spherical structure. From the EDAX spectra, the elemental compositions were identified. The optical studies were carried out using UV-Vis and Photoluminescence spectra for CeO<sub>2</sub> NPs, respectively.

**Keywords:** Photosynthesis; CeO<sub>2</sub>; Nanoparticles; Optical studies.

## 1. INTRODUCTION

The CeO<sub>2</sub> nanoparticles could be a technologically potent material with remarkable properties utilized in a variety of applications in Environmental science. The CeO<sub>2</sub> nanoparticles have been used as three-way catalysts (TWC) for exhaust gas treatment from automobiles, polishing agents for the chemical, mechanical planarization (CMP) process, gate oxides in metal oxide semiconductor devices, and ultraviolet (UV) blocking materials in UV shielding, respectively (Wang *et al.* 2003; Tsunekawa and Kumar, 2000).

The synthesized CeO<sub>2</sub> NPs were prepared by physical and chemical methods such as hydrothermal, flame spray pyrolysis, sonochemical, microwave, sol-gel, and co-precipitation. However, most of the techniques are difficult, time-intense, high priced, and unsafe. Green chemistry approaches the event in photosynthesis of metal and metal oxide NPs. This method offers several benefits like cost-effectiveness, large-scale industrial production, and pharmaceutical applications.

In the present investigation, CeO<sub>2</sub> NPs are prepared through the *Azadirachta indica* leaf extract.

## 1.1 Material and Methods

### 1.1.1 Green Synthesis CeO<sub>2</sub> NPs

The 10 g of finely divided leaves of *Azadirachta indica* was added to 100 mL of double distilled water and boiled at 50-60°C for 10 min. The solution was filtered through Whatmann No. 1 filter paper, and the clear filtrate was collected and which were carried for further usage. Thereafter, add a certain quantity of 0.1M solution of cerium nitrate to 100 mL of *A. indica* leaf extract with constant stirring at 80 °C for 6h. The Initially brown precipitate was formed, and then it becomes a yellowish-brown in color on continuous stirring. Finally, the precipitate was dried at 120 °C. The precipitate was annealed at 400 °C for 5h to get spherical NPs.

### 1.1.2 Characterization Techniques

The CeO<sub>2</sub> NPs were characterized by an X-ray diffractometer (model: X'PERT PRO PANalytical). The diffraction patterns were recorded in the range of 20°-80° for the CeO<sub>2</sub> NPs samples, where the monochromatic wavelength of 1.54 Å was used. The XPS measurements were performed with an XPS instrument (Carl Zeiss) equipment. The spectra were at a pressure using an ultra-

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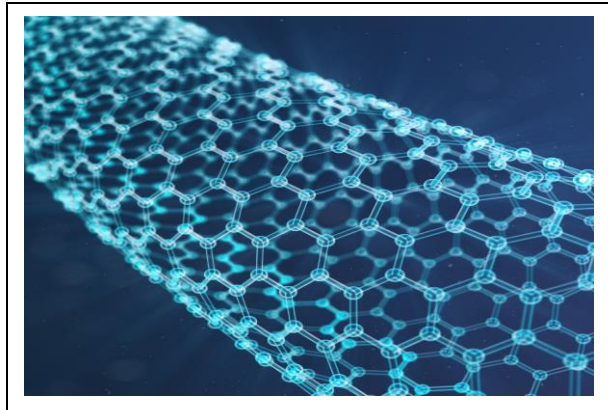
J. Fuzzy Intell. Model. Optim., Vol. 1(1), 31-10 (2025)  
<https://doi.org/10.13074/jfimo.202x.0x.221514>

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**Fig. 4: Morphology images of (a) FESEM, (b) TEM and (c) EDAX spectra of CeO<sub>2</sub> NPs. Morphology images of (a) FESEM, TEM and EDAX spectra of CeO<sub>2</sub> NPs. Morphology images of (a) FESEM, TEM and EDAX spectra of CeO<sub>2</sub> NPs**

**Table 1. Eigenvalue, percentage of variance, and cumulative percentage estimated by PCA on the correlation matrix of the normalized frequency response of SAW e-Nose device**

Principal Component Number	Eigenvalue	Percentage of Variance (%)	Cumulative (%)
1	2.42 x 10 <sup>7</sup>	71.25	71.25
2	0.42 x 10 <sup>7</sup>	12.21	83.46
3	0.30 x 10 <sup>7</sup>	08.88	92.34
4	0.18 x 10 <sup>7</sup>	05.25	97.59

**REFERENCES**

Arumugam, A., Karthikeyan, C., Haja Hameed, A. S., Gopinath, K., Gowri, S. and Karthika V., Synthesis of cerium oxide nanoparticles using *Gloriosasuperba L.* leaf extract and their structural, optical and antibacterial properties, *Mater. Sci. Eng. C.*, 49(1), 408-415(2015).  
<https://doi.org/10.1016/j.msec.2015.01.042>

**CITATION**

- (AuthorName *et al.* year)  
 (Kesav *et al.* 2015), (Kesav *et al.* 2015; Arjun *et al.* 2013)
- (AuthorName1 and AuthorName2, year)  
 (Kesav and Arjun, 2013)

**REFERENCE**

**1. Journal Articles**

AuthorName1, Initail., AuthorName2, Initail1.Initail2.  
 And AuthorName3, Initail., Article Title, *Journal*

*Abbreviation*, Volume(Issue), StartPage-EndPage (Year).  
 DOI

Arumugam, A., Karthikeyan, C., Haja Hameed, A.S., Gopinath, K., Gowri, S. and Karthika V., Synthesis of cerium oxide nanoparticles using *Gloriosasuperba L.* leaf extract and their structural, optical and antibacterial properties, *Mater. Sci. Eng. C.*, 49(1), 408-415 (2015).  
<https://doi.org/10.1016/j.msec.2015.01.042>

**2. Books**

Kays, W.M. and London, A.L., Compact Heat Exchangers, 2nd Ed., Mc Graw Hill, New York, 97-108 (1984).

**3. Paper in Edited Books**

Roy, C., Pakdel, H. and Labrecque, B., Vacuum Pyrolysis of Used Tires, J.P. Hartnett and T.F. Irvine, Eds., Vol. 8, 212-235, Academic Press, New York (1973).

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