# ENHANCED OPTICAL CHARACTEIZATION OF CASSAVA STARCH MEDIATED CERIUM OXIDE NANOPARTICLES

**R. Sankaraeswari, S. Irudaya Sahaya Lancy**

Department of Physics, St. Mary's College (Autonomous), Thoothukudi,

Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

**ABSTRACT:**

Cerium oxide ($CeO_2$) nanoparticles have gained significant attention due to their unique optical and catalytic properties. This study explores the synthesis of $CeO_2$ nanoparticles using cassava starch as a natural mediator. The biosynthesis approach enhances particle stability, reduces aggregation, and provides an eco-friendly alternative to conventional chemical methods. The structural and optical properties of the synthesized nanoparticles were analysed using UV-Vis spectroscopy, with a Tauc plot employed to determine the optical band gap. The results indicate that cassava starch plays a crucial role in controlling nanoparticle size and enhancing optical performance. The synthesized $CeO_2$ nanoparticles exhibit promising potential for applications in catalysis, sensors, and biomedical fields.

**KEYWORDS**: $CeO_2$ (Cerium oxide), Cassava Starch, UV-VIS Spectroscopy.

## 1.INTRODUCTION

Cassava starch, obtained from the roots of Manihot esculenta Crantz, is a versatile natural polymer widely used in food, pharmaceutical, and cosmetic industries due to its biodegradability, renewability, and cost-effectiveness [1]. Beyond its conventional applications, cassava starch has recently attracted attention in nanotechnology as a green stabilizing and mediating agent for nanoparticle synthesis, offering an eco-friendly alternative to chemical stabilizers. Cerium, a rare earth metal belonging to the lanthanide series (atomic number 58), exists in +3 and +4 oxidation states and forms cerium oxide ($CeO_2$), a technologically significant material with unique optical and catalytic properties [2]. $CeO_2$ is extensively used as an ultraviolet absorber, catalyst, polishing agent, and gas sensor material, and plays a vital role in solid oxide fuel cells due to its excellent oxide ion conductivity [3]. In recent years, nanostructured $CeO_2$ has gained increasing importance in biomedical applications, demonstrating protective effects against radiation and oxidative stress, as well as therapeutic potential in conditions such as brain and cardiac ischemia, neurological disorders, and retinal neurodegeneration [4]. Considering these advantages, the present study focuses on developing an environmentally friendly method for $CeO_2$ nanoparticle synthesis using cassava starch as a natural mediator. The objectives of this work are to extract cassava

starch from tapioca roots, synthesize $CeO_2$ nanoparticles using cassava starch as a green reagent, investigate their structural properties, and analyze their optical characteristics through UV-Vis spectroscopy.

**Fig:1 Cassava Starch**

## 2.MATERIALS AND METHODS

Fresh cassava tubers (100 g) were thoroughly washed, peeled, and shredded, then liquefied with 200 ml of distilled water. The resulting mixture was screened using muslin cloth, and the filtrate was collected. The filtrate was allowed to settle, the supernatant was discarded, and the starch sediment was collected from the bottom of the beaker. For nanoparticle synthesis, 100 g of cassava root extract was prepared by grinding the tubers in a blender, and the resulting solution was mixed with 100 ml of 1 M cerium solution. The mixture was continuously stirred using a magnetic stirrer for approximately 4 hours to promote nanoparticle formation. The precipitate obtained was washed five times with ethanol and distilled water to remove impurities, then dried in a hot air oven and annealed at 300 ℃ for 2 hours. The synthesized cerium oxide nanoparticles were characterized using UV-Vis spectroscopy to analyse their optical properties.

**Fig:2 Prepared $CeO_2$ Nanoparticles**

## 3.RESULT AND DISCUSSION

### V – VIS Spectroscopy

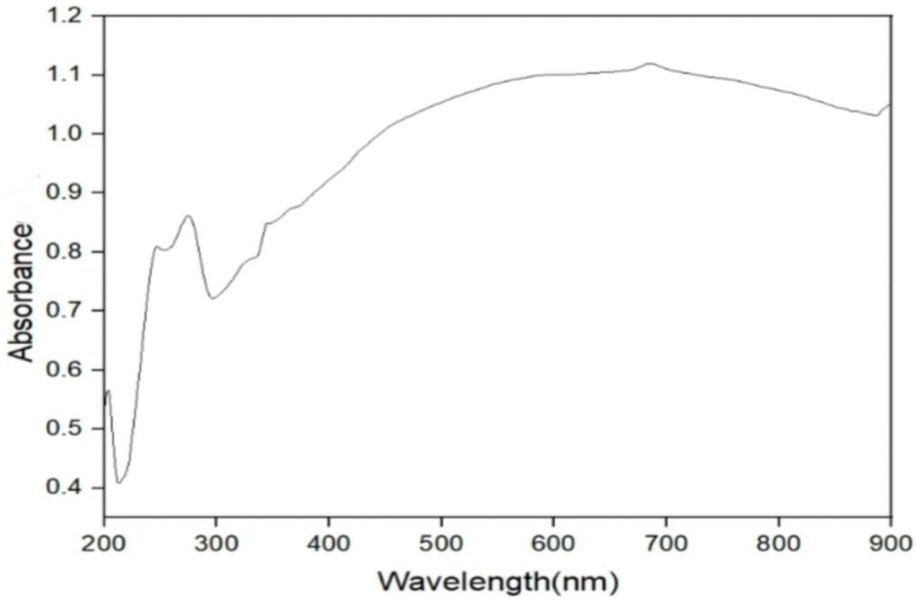


**Fig:3 UV-VIS Spectra of the $CeO_2$ Nanoparticles**

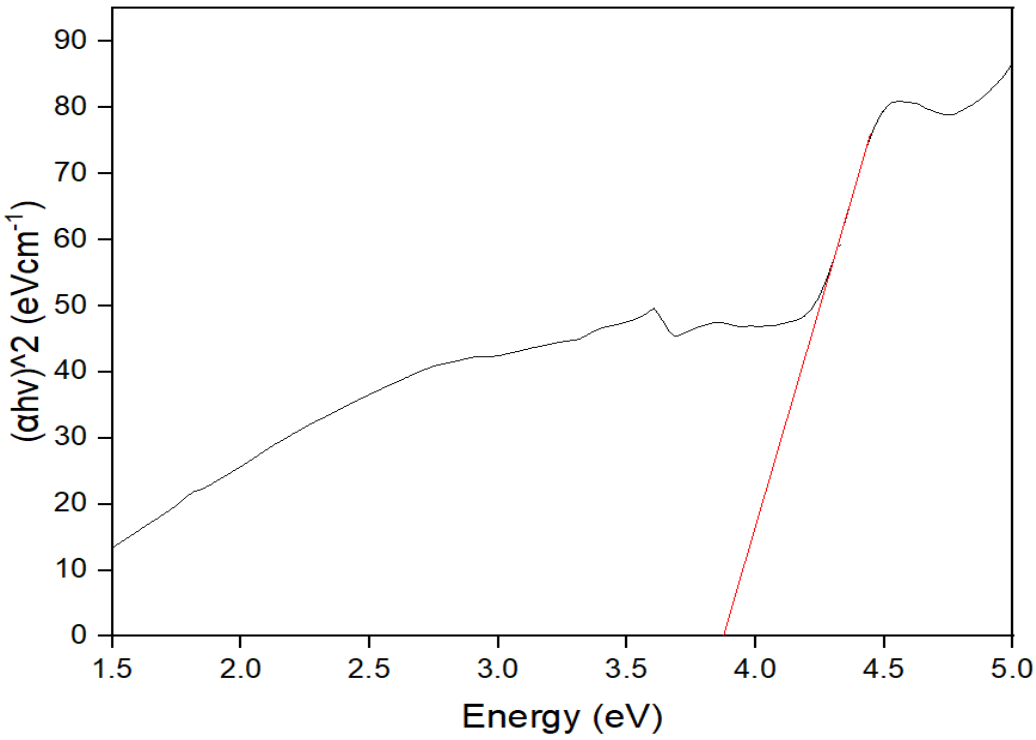


**Fig:4 Tauc plot of $CeO_2$ Nanoparticles**

**Optical Band Gap Analysis of $CeO_2$ Nanoparticles:** The optical properties of cerium oxide ($CeO_2$) nanoparticles synthesized using cassava starch were analysed using UV-Vis spectroscopy. The Tauc plot, derived from the absorbance spectrum, was used to estimate the optical band gap energy (Eg). The extrapolation of the linear region to the x-axis provides the optical band gap of the synthesized nanoparticles. From the graph, the estimated band gap energy was found to be 3.8 eV.

This value is higher than the reported band gap of $CeO_2$ (~3.2 eV), indicating the influence of quantum confinement effects due to the nanoscale dimensions of the synthesized nanoparticles. The increase in band gap suggests a reduction in particle size, which is consistent with previous studies on nanostructured $CeO_2$. Furthermore, the successful synthesis of $CeO_2$ nanoparticles using cassava starch as a green stabilizing agent demonstrates the potential of eco-friendly synthesis methods in nanomaterial production.

## 4.CONCLUSION

The successful synthesis of $CeO_2$ nanoparticles using cassava starch demonstrates the viability of a green and sustainable approach for nanomaterial production. The obtained nanoparticles exhibit a wide band gap of 3.8 eV, making them suitable for applications requiring high optical transparency and photocatalytic activity. The role of cassava starch in stabilizing and mediating the growth of nanoparticles highlights its potential as a cost-effective and biodegradable alternative to synthetic stabilizers. These findings pave the way for further exploration of biogenic synthesis routes for advanced nanomaterials with enhanced functionalities.

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