

POSTER PRESENTATION

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# Antimicrobial activity of nano cerium oxide (IV) (CeO<sub>2</sub>) against *Streptococcus mutans*

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## Background

Cerium oxide (CeO<sub>2</sub>) is a technologically important material due to its properties and applications in several areas that range from engineering to biological sciences. Despite the hydrothermal microwave method versatility, its crystallization kinetics has low speed when the processing temperatures are below 300°C which are the desired conditions for soft chemistry processes [1,2]. At lower temperatures it was found that this material has antimicrobial activity against several bacteria, including *E. coli*, *B. subtilis*, *Shewanellaoneidensis* and *Pseudokirchneriella subcapitata*, destroying microorganisms cell walls by probable action of reactive oxygen species [3]. When nanoparticles of CeO<sub>2</sub> crystals are synthesized (IV), the antimicrobial activity can be better controlled and its spectrum of applications expanded.

## Methods

In this work, cerium oxide nanoparticles (IV) were synthesized by the hydrothermal method, assisted by microwave, with a 150°C temperature, approximately, at intervals of 10, 15 and 20 minutes. Their structural, morphological and microbiological characteristics were studied by x-ray diffraction (XRD), high-resolution electronic scanning microscopy, (FEG-SEM), electronic microscopy of transmission (TEM), BET method, infrared spectroscopy (IR), resazurin, spectrophotometry, fluorescence and agar diffusion.

## Results

All XRD samples showed peaks corresponding to planes (1 1 1), (2 0 0), (0 2 2), (3 1 1), (2 2 2) and (4 0 0) of a centered face cube, fluorite, attributed to CeO<sub>2</sub> (I) according

to law JCPDS 34-0394. Broad reflection peaks were clearly visible, demonstrating that the crystal size is small and must be in the nanoscale dimension, which indicates the efficiency of the method for obtaining this nanostructured material. Infrared spectra showed a band of vibration between 700 and 500 cm<sup>-1</sup> related to the vibration of the metal- oxygen (Ce-O) and other results. Their surface areas were approximately 200m<sup>2</sup>/g with around particle sizes of 5nm. Micrographs showed different sizes and shapes of clusters. Microbiological tests against *Streptococcus mutans* for the containing nano cerium oxide (IV) composite in ZnO at 10% (diluted in BHI- broth) showed antibacterial effect in minimum inhibitory concentration of 0.22 mg/mL.

## Conclusions

The results showed the direct influence of the synthesis method employed on the morphology and size of nanoparticles cerium oxide (IV) obtained. Nano cerium oxide (IV) seems to be a material of great potential for use against *S. mutans* (a dental bacteria) responsible for cariogenic process due to its purity and particle size. The matching results among the tests employed in biological assays showed that the techniques of fluorescence, spectrophotometry, resazurin and fluorescence did not suffer reagent interference as may eventually occur with some products of natural origin. The dental composite consisting of odontologic ZnO and nanometer CeO<sub>2</sub> in the proportion of 10 % showed superior antimicrobial properties when compared to the standard used (dental zinc oxide + eugenol).

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#### References

1. Komarneni S: Nanophase materials by hydrothermal, microwave-hydrothermal and microwave-solvothermal methods. *Current Science* 2003, **85**:1730-1734.
2. Deus RC, Cilense M, Foschini CR, Ramirez MA, Longo E, Simões AZ: Influence of mineralizer agents on the growth of crystalline CeO<sub>2</sub>nanospheres by the microwave-hydrothermal method. *Journal of Alloys and Compounds* 2013, **550**:245-251.
3. Santos CL, Albuquerque AJR, Sampaio FC, Keyson D: **Nanomaterials with Antimicrobial Properties: Applications in Health Sciences**. In *Microbial pathogens and strategies for combating them: science, technology and education. Volume 4*. Microbiology Book Series;Formatex Research Center. Badajoz, Spain 2013.

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