



Synthesis and Characterization of Nano-structured in Nanotechnolof

Dr. Amit Kumar Gupta*

Assistant Professor, Parishkar College of Global Excellence, India

ABSTRACT

Microspheres covered with micro cuboids/nanorods and nanoparticles of BaHPO₄/Ba₃(PO₄)₂/Ba₅(PO₄)₃OH phases have been successfully synthesized by a facile hydrothermal (HT) method using the citric acid as a surfactant at different pH values. X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM) and fluorescence spectrometry were used to characterize the samples. It was found that the pH value was a crucial factor for the phase formation and shape determination of the final products, which were discussed in detail. Attractively, the as-prepared BaHPO₄/Ba₃(PO₄)₂/Ba₅(PO₄)₃OH samples emitted an intense blue light in a broad band from 380 to 625 nm, for which the mechanism was complex ions luminescence originating from the transition of 3T₁ → 1A₁ in PO₄³⁻. Meanwhile, an obvious red shift for the emission band was observed between nano- and bulk-Ba₃(PO₄)₂ synthesized by HT and conventional solid-state (CSS) reactions, respectively, which was due to the effect of the product being nanosized.

Keywords: XRD; SEM; TEM Ethylene Diamine Tetra Acetic acid (EDTA); Perovskite materials (barium zirconate, strontium zirconate and calcium zirconate), Debye Scherrer's Formula; EDX

INTRODUCTION

The successful synthesis of large-scale nanostructured materials with grain sizes in the range of 10-200 nm represents a major achievement in the emerging field of nanotechnology. The scientific literature indicates that there are many techniques that can be used to produce nanostructured materials, including inert gas condensation or chemical vapor condensation [1, 2], pulse electron deposition, plasma synthesis, crystallization of amorphous solids severe plastic deformation, and consolidation of mechanically alloyed or cryomilled powders. However, only a few of these techniques, such as electrodeposition and consolidation of mechanically alloyed/cryomilled powders generate nanostructures with sufficient thermal stability to permit the fabrication of bulk materials [3]. Water, a natural solvent is known to exhibit unique properties under supercritical conditions and this has been suitably exploited to promote dissolution, diffusion, adsorption, reaction rate, nucleation and growth for the synthesis of ceramics. Over the past decade, hydrothermal synthesis has been widely used to produce weakly aggregated fine powders of both binary and mixed oxides under mild conditions [4]. There is also considerable interest in the synthesis of oxide materials via microwave heating both at atmospheric pressure and under hydrothermal conditions, which notably accelerates chemical reactions [5]. In combustion synthesis, the exothermicity of the redox (reduction-oxidation or electron transfer) chemical reaction is used to produce useful materials. By

controlling the processing parameters such as microwave initiation, gravity, precursors and additives to redox mixtures; it has been possible to obtain nanosize oxides using combustion synthesis [6]. In this paper, the preparation and property analysis have been planned for single perovskites barium zirconate, strontium zirconate and calcium zirconate using a modified single-step auto-igniting combustion process.

Synthesis of nanocrystalline ABO₃

To produce powders of high phase purity, repeated grinding and re-firing is necessary to sufficiently complete the solid-state reaction of BaCO₃ and ZrO₂. BaZrO₃ is a highly refractory material, and extended mechanical grinding is typically required to sufficiently reduce the particle size to allow sintering to high density [7]. For present investigations, nanoparticles of ABO₃ (A=Ba, Sr & Ca; B=Zr) have been synthesized using a modified single step combustion process. An aqueous solution containing ions of A (A=Ba, Sr & Ca) and Zr was prepared by dissolving stoichiometric amount of high purity A(NO₃)₂ (99%, CDH, India) and ZrOCl₂·8H₂O (99%, CDH, India) in 200ml distilled water in a glass beaker. Citric acid (99%, CDH, India) was then added to the solution containing A (A=Ba, Sr & Ca) and Zr ions. Amount of citric acid was calculated based on total valence of the oxidizing and reducing agents for maximum release of energy during combustion [8]. In the preparation of nanoparticles of other ceramic oxides using combustion process

*Correspondence to: Dr. Amit Kumar Gupta, Assistant Professor, Parishkar College of Global Excellence, India, E-mail sumitguptagir@gmail.com

Received: 02-Mar-2023, Manuscript No: jnmnt-23-20457, Editor assigned: 06-Mar-2023, Pre QC No: jnmnt-23-20457 (PQ), Reviewed: 22-Mar-2023, QC No jnmnt-23-20457, Revised: 25-Mar-2023, Manuscript No: jnmnt-23-20457 (R), Published: 31-Mar-2023, DOI: 10.35248/2157-7439.23.14.669.

Citation: Gupta AK (2023) Synthesis and Characterization of Nano-structured in Nanotechnology. J Nanomed Nanotech. 14: 669.

Copyright: ©2023 Gupta AK. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

(Kingsley end Patil 1988; Pramanik 1999), polyvinyl alcohol and urea were used as the complexing agent and fuel, respectively [9]. In these cases, usual calcinations of the combustion product were essential to get a single phase nano material [10]. In the present combustion method, citric acid was used as the complexing agent instead of polyvinyl alcohol and urea was replaced with ammonia. Using this complexing agent and oxidant fuel system, it was possible to get a single phase $AZrO_3$.

CONCLUSION

Nanoparticles of ABO_3 (A= Ba, Sr & Ca; B=Zr) have been synthesized using modified single step combustion method for the first time. All the peaks of the XRD are indexed and no peaks are observed other than the expected peaks of the respective nanopowders. The analysis results show that they are isostructural and no trace of any impurities. Only the as-prepared powder of $CaZrO_3$ needs an annealing of about 700 °C for 1 h. Their lattice parameters are agreed well with JCPDS values. While annealing the $SrZrO_3$ sample to 600 °C, the crystallinity increases. The scanning electron micrographs reveal a very homogeneous microstructure without agglomerates or exaggerated grain growth. There are no pores which signify the enhancement of density. Fine crystalline nature is observed in transmission electron micrographs.

REFERENCES

1. Levecke B, Montresor A, Albonico M, Ame SM, Behnke JM, Bethony JM, et al. Assessment of anthelmintic efficacy of mebendazole in school children in six countries where soil-transmitted helminths are endemic. *PLoS Negl Trop Dis*. 2014;8(10):e3204.
2. Gabrielli AF, Montresor A, Chitsulo L, Engels D, Savioli L. Preventive chemotherapy in human helminthiasis: theoretical and operational aspects. *Trans R Soc Trop Med Hyg*. 2011;105(12):683-693.
3. Tine RCK, Faye B, Ndour CTL, Sylla K, Sow D, Ndiaye M, et al. Parasitic infections among children under five years in Senegal: Prevalence and effect on anaemia and nutritional status. *Isrn Parasitol*. 2013.
4. Giannakou C, Park MV, Jong WHD, Loveren HV, Vandebriel RJ, et al. A comparison of immunotoxic effects of nanomedicinal products with regulatory immunotoxicity testing requirements. *Int J Nanomedicine*. 2016; 11:2935-52.
5. Chen RJ, Chen YY, Liao MY, Lee YH, Chen ZY, et al. The Current Understanding of Autophagy in Nanomaterial Toxicity and Its Implementation in Safety Assessment-Related Alternative Testing Strategies. *Int J Mol Sci*. 2020; 21(7):2387.
6. Dusinska M, Tulinska J, El Yamani N, Kuricova M, Liskova A, et al. Immunotoxicity, genotoxicity and epigenetic toxicity of nanomaterials: New strategies for toxicity testing?. *Food Chem Toxicol*. 2017; 109(Pt 1):797-811.
7. Levecke B, Montresor A, Albonico M, Ame SM, Behnke JM, Bethony JM, et al. Assessment of anthelmintic efficacy of mebendazole in school children in six countries where soil-transmitted helminths are endemic. *PLoS Negl Trop Dis*. 2014;8(10):e3204.
8. Gabrielli AF, Montresor A, Chitsulo L, Engels D, Savioli L. Preventive chemotherapy in human helminthiasis: theoretical and operational aspects. *Trans R Soc Trop Med Hyg*. 2011;105(12):683-693.
9. Tine RCK, Faye B, Ndour CT., Sylla K, Sow D, Ndiaye M, et al. Parasitic infections among children under five years in Senegal: Prevalence and effect on anaemia and nutritional status. *Isrn Parasitol*. 2013.
10. Melaku W, Solomon G. Prevalence of intestinal protozoa and soil transmitted helminths infections among school children in Jaragedo Town, South Gondar zone of Ethiopia. *J Trop Med*. 2022;5747978.