Daniel Damian, Florentina Cziple, Adina Segneanu, Ioan Grozescu

Simple Synthesis Method for Alumina Nanoparticle

Globally, the human population steady increase, expansion of urban areas, excessive industrialization including in agriculture, caused not only decrease to depletion of non-renewable resources, a rapid deterioration of the environment with negative impact on water quality, soil productivity and of course quality of life in general.
This paper aims to prepare size controlled nanoparticles of aluminum oxide using a simple synthesis method. The morphology and dimensions of nanomaterial was investigated using modern analytical techniques: SEM/EDAX and XRD spectroscopy

Keywords: aluminum oxide, hydrothermal, nanoparticles, termic treatment

1. Introduction

Over 20 percent of the entire population lives in geographical regions with limited water resources. In this context there are required immediately measures to combat continue environmental degradation. Expanding the nanotechnology applications in this area can represent a viable solution. Many studies reported the beneficial effects of nanotechnologies over the wastewater efficiency, quality and cost compared with conventional methods. Moreover, the nanomaterials properties can be designed to overcome current limitations and increase its performance. [1-3]
Research on alumina or aluminum oxide nanoparticles have shown many different applications. It can be used as biomaterial [3] but also at wastewater treatment [9] are just a few of these.
This paper aims to obtain alumina with controlled nanoparticles size into a simple and efficient manner.

2. Material and methods

All used reagents and solvents were purchased from commercial sources (Merck, Fluka) and used without a further purification. The synthesis method selected was thermic treatment in hydrothermal media at high temperature and presurre.

3. Experimental

Synthesis

From the plurality of obtained methods reported in literature [4-8] was selected the hydrothermal treatment for the synthesis of alumina nanoparticles from $Al(NO_3)_3$ (0.62 g) and KOH (0.2 M, 0.36 g). The reaction mixture is maintained under stirring at room temperature for 10 minute. Than was introduce into an autoclave at 350°C and 1100 barrs for 24 hours. The result mixture was filtrate and washed with deionised water to neutral pH. The solid white was calcinated at 900°C. X-ray diffraction and SEM/EDX analysis were used for the characterization of nnomaterial.

Characterization of aluminium oxide nanoparticles

The crystallinity of the alumina nanoparticles was investigated by X-Ray diffraction (XRD) using PANalytical X'PertPRO MPD Difractometer with Cu Kα radiation λ = 1.5406Å, 2θ-step of 0.01◦ from 10 to 100. Scherrer equation, $d = 0.9\lambda/ (B \cos \theta)$ was used to estimate grain average sizes of crystallites,
where B is the half height width of the reflection peak at 2θ and λ is the wavelength of the radiation. Scherrer equation, $d = 0.9\lambda/ (B \cos \theta)$ was used to estimate grain average sizes of crystallites, where B is the half height width of the reflection peak at 2θ and λ is the wavelength of the radiation.

The morphology of obtained nanomaterials was observed using an Inspect S PANalytical model scanning electron microscopy (SEM) using coupled with the energy dispersive X-ray analysis detector (EDX). The semiquantitative elemental analysis was analyzed through EDAX facility of SEM.

4. Results and discussion

X-ray diffraction (XRD)

Figure 1 show XRD patterns of nanomaterial. The presented results revealed the presence of coryndum and monoclinic phases.

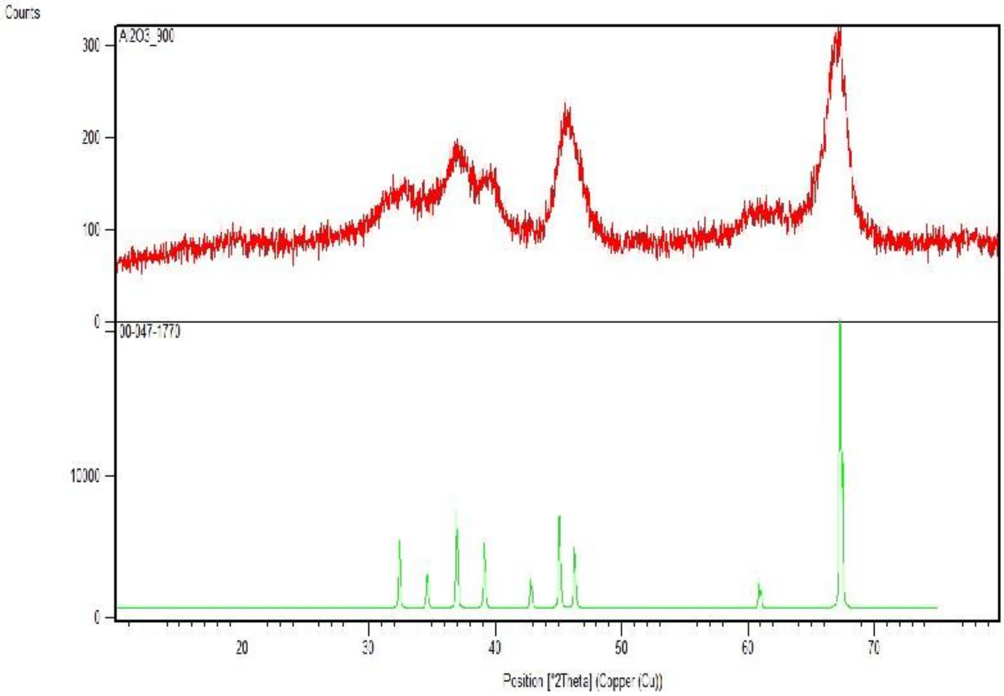

Figure 1. XRD pattern of alumina nanoparticles

SEM-EDAX

The resuts indicates that nanomaterial synthesized is pure since in EDX graph are found only specific peaks for aluminum and oxygen (Figure 2)

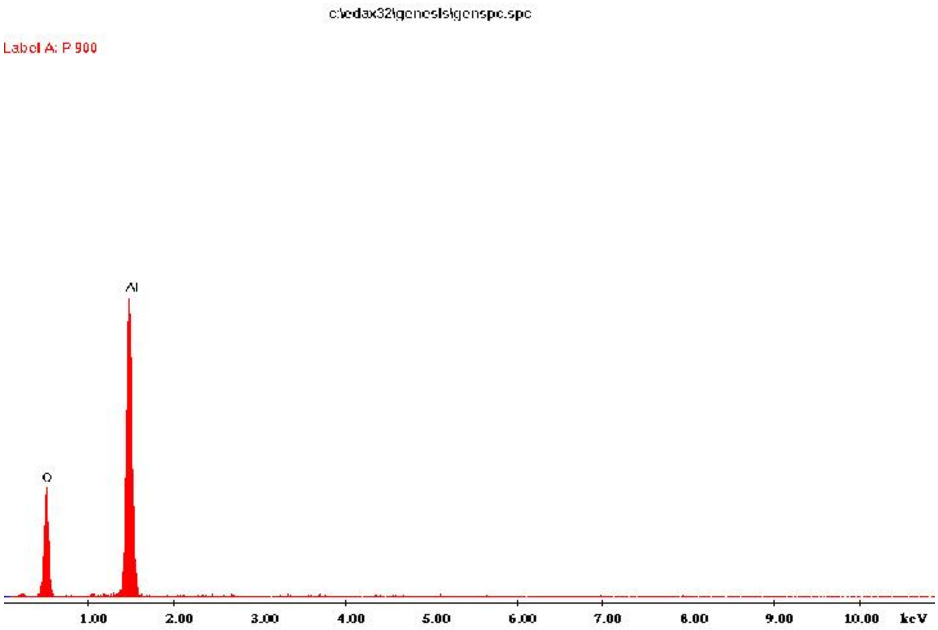

Figure 2. EDAX elemental analysis of alumina nanomaterial

From the SEM images (Fig. 3.) can be observed the surface topography of sample. From the SEM images (Fig. 3.) can be observed the surface topography of sample.

The obtained nanoparticles have regular geometric shapes which can be assimilated with spheres with diameters between3 and 5 µm. It can be considerate that formations agglomerated from the center of Figure 3 are assigned to coryndrum spheres with dimensions of which size is between 0.5-1 µm. This indicates that, depending on the physical parameters (pressure and temperature) the size corundum nanoparticle can be controlled using this method of synthesis

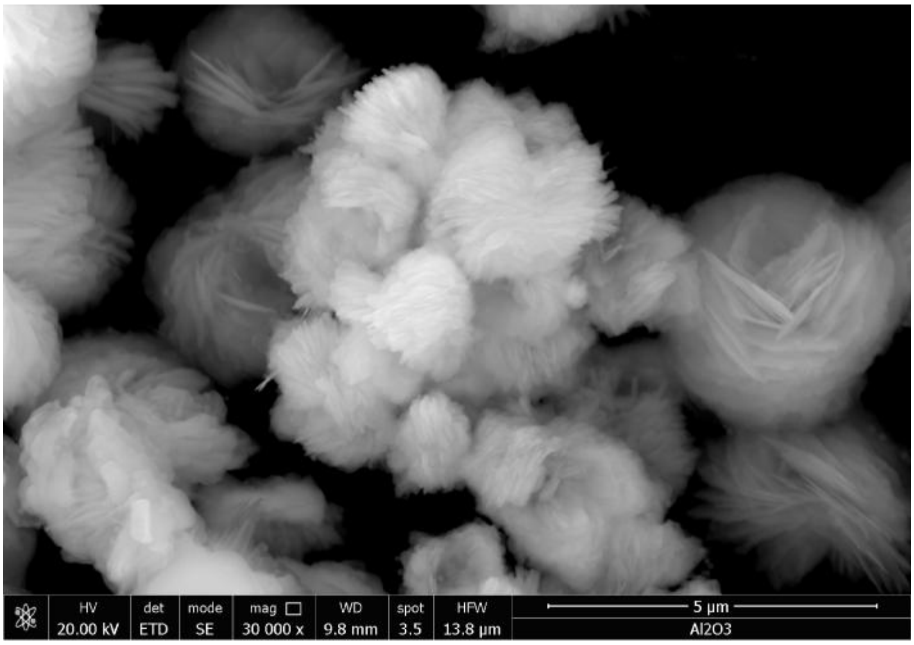

Figure 3. SEM micrograph of alumina nanoparticles

4. Conclusion

The present study investigates synthesis of nanoparticles of alumina with controlled size (smaller than 10 µm) using hydrothermal treatment. The morphological and structural analysis of nanomaterial obtained demonstrated the efficiency of the method. The properties (dimension) of nanoparticles thereby justifying further applied research and development of advanced material for sustaineble water management.

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Addresses:

- PhD Student Eng. Daniel Damian, University Politehnica Timisoara, Piaţa Victoriei, nr. 2, 300006; Timisoara, danieldamian83@gmail.com
- Prof. Dr. Eng. Florentina Cziple, “Eftimie Murgu” University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, f.cziple@uem.ro
- Dr. Adina Segneanu, Scient –Research Center for Instrumental Analysis, Cromatec Plus, Tancabesti, Snagov, 077167 Ilfov, Romania Romania, s_adinaelena@yahoo.com
- Prof.Dr. Ioan Grozescu, University Politehnica Timisoara, Piaţa Victoriei, nr. 2, 300006, Timisoara, ioangrozescu@gmail.com