Materials Letters 62 (2008) 4184–4186

Contents lists available at ScienceDirect

Materials Letters

journal homepage: www.elsevier.com/locate/matlet

Boehmite nanopetals self assembled to form rosette-like nanostructures

Mahyar Mazloumi [a], Mehdi Attarchi [a], Aidin Lak [a,b], Matin Sadat Mohajerani [a,b], Amir Kajbafvala [a,b], Saeid Zanganeh [a], S.K. Sadrnezhaad [a,b,⁎]

[a] Nanomaterials Research Group, Materials and Energy Research Center, 14155-4777, Tehran, Iran
[b] Center of Excellence for Production of Advanced Materials, Department of Materials Science and Engineering, Sharif University of Technology, Tehran, P.O. Box 11365-9466, Iran

ARTICLE INFO

Article history:
Received 14 February 2008
Accepted 2 June 2008
Available online 15 June 2008

Keywords:
Boehmite
Ceramics
Nanomaterials
Nanopetal
Self assembly

ABSTRACT

Rosette-like boehmite nanostructures were prepared successfully via a simple hydrothermal process. The obtained material was characterized with X-ray powder diffractometry (XRD), transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Using Scherrer formula, the average crystallite size of the obtained boehmite rosettes was measured to be about 8 nm. It was shown that boehmite nanopetals with average width of about 41 nm determined by TEM, were formed during the hydrothermal process and then self assembled due to weak hydrogen bonds to fabricate boehmite rosettes. The specific surface area of the obtained rosette-like nanostructures was calculated through BET N_2-adsorption technique to be about 143.08 m^2/g.

1. Introduction

Boehmite (AlOOH) is an important material which can be utilized industrially as the catalyst [1] or the precursor of the catalysts [2] and adsorbents [3]. Transition alumina phases (γ, δ, θ) and the thermodynamically stable α-alumina phase, can be simply obtained through the thermal treatment of boehmite at elevated temperatures [4]. Since the transition phases can retain the morphology of the preliminary boehmite phase [5], preparation of boehmite nanoarchitectures as an initial template for other alumina phases has attracted the researchers' attentions during the last decade. Up to date, various boehmite nanostructures such as nanotubes [6], nanostrips [7], nanorods [8], nanofibers [9-11], nanoribbons [12], nanowires [13], bunches of nanowires [14], nanoplatelets [13,15] and 3D flower-like nanostructures [1], were prepared through chemical processes. These fascinating boehmite nanostructures can also become nanocalcined to prepare mesoporous α-alumina nanotemplates for the growth of one-dimensional nanostructures [7].

Self assembly has been proposed as a principle mechanism for the formation of different nanoarchitectures in chemical processes [1,16–19]. It is defined as the spontaneous formation of larger building blocks from primary structures and has great potential applications in nanoscience and nanotechnology [20,21]. In this article we have investigated the self assembly of boehmite nanopetals to form rosette-like nanoarchitectures through a simple hydrothermal process. Based on our literature survey on the hydrothermal synthesis of boehmite nanostructures, this is the first time to report the formation of rosette-like nanoarchitectures from self-assembled primary nanopetals.

2. Experimental

In a typical experimental route for synthesis of boehmite rosettes the following procedure was carried out in which all the raw materials were purchased from Merck (Darmstadt, Germany) company in the analytical grade: 0.56 g of $Al(NO_3)_3.9H_2O$ powder was dissolved into 10 ml absolute ethanol under vigorous stirring at room temperature for 2 h until the particles of hydrous aluminum nitrate were completely disappeared. The resultant colorless solution was poured into a Teflon-lined stainless steel autoclave with a volume of 100 ml. The autoclave was then sealed completely and maintained at 200 °C for 24 h under autogenous pressure control. After the reactions were completed, the autoclave was cooled down naturally to the room temperature. The obtained precipitate was filtered with centrifuge equipment, washed with deionized water several times to remove the probable impurities and dried in an oven at 60 °C for 24 h. The obtained powders were characterized with scanning electron microscopy (SEM, Philips XL30), transmission electron microscopy equipped with a field emission gun (FEG-STEM, Philips CM200) and X-ray diffraction analysis (XRD, Siemens D500 diffractometer). The specific surface area of the powder was determined through nitrogen adsorption by Brunauer–Emmet–Teller method (BET-N_2 adsorption,

⁎ Corresponding author. Nanomaterials Research Group, Materials and Energy Research Center, 14155-4777, Tehran, Iran. Tel.: +98 261 6210009; fax: +98 261 6201818.
E-mail address: sadrnezh@sharif.edu (S.K. Sadrnezhaad).

0167-577X/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.matlet.2008.06.025