World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:04, 2018

Role of Cellulose Fibers in Tuning the Microstructure and Crystallographic Phase of α-Fe_2O_3 and α-FeOOH Nanoparticles

Authors : Indu Chauhan, Bhupendra S. Butola, Paritosh Mohanty

Abstract : It is very well known that properties of material changes as their size approach to nanoscale level due to the high surface area to volume ratio. However, in last few decades, a tenet 'structure dictates function' is quickly being adopted by researchers working with nanomaterials. The design and exploitation of nanoparticles with tailored shape and size has become one of the primary goals of materials science researchers to expose the properties of nanostructures. To date, various methods, including soft/hard template/surfactant assisted route hydrothermal reaction, seed mediated growth method, capping molecule-assisted synthesis, polyol process, etc. have been adopted to synthesize the nanostructures with controlled size and shape and monodispersity. However controlling the shape and size of nanoparticles is an ultimate challenge of modern material research. In particular, many efforts have been devoted to rational and skillful control of hierarchical and complex nanostructures. Thus in our research work, role of cellulose in manipulating the nanostructures has been discussed. Nanoparticles of α-Fe_2O_3 (diameter ca. 15 to 130 nm) were immobilized on the cellulose fiber surface by a single step in situ hydrothermal method. However, nanoflakes of α-FeOOH having thickness ca. ~25 nm and length ca. ~250 nm were obtained by the same method in absence of cellulose fibers. A possible nucleation and growth mechanism of the formation of nanostructures on cellulose fibers have been proposed. The covalent bond formation between the cellulose fibers and nanostructures has been discussed with supporting evidence from the spectroscopic and other analytical studies such as Fourier transform infrared spectroscopy and X-ray photoelectron spectroscopy. The role of cellulose in manipulating the nanostructures has been discussed.

Keywords : cellulose fibers, α-Fe_2O_3, α-FeOOH, hydrothermal, nanoflakes, nanoparticles
Conference Title : ICBMC 2018 : International Conference on Biobased Materials and Composites
Conference Location : Paris, France
Conference Dates : April 19-20, 2018