SYNTHESIS OF NANO-POROUS IRON YTTRIUM OXIDE PARTICLES FROM SRI LANKAN NATURAL GARNET SAND

Anoja Senthilnathan[1,2*], D.M.S.N. Dissanayake[1,3], M.M.M.G.P.G. Mantilaka[1,3] and K.M. Nalin de Silva[1]

[1]Sri Lanka Institute of Nanotechnology, Nanotechnology and Science Park, Mahenwatte, Pitipana, Homagama.
[2]Department of Science and Technology, Uva Wellassa University, Badulla.
[3]Postgraduate Institute of Science, University of Peradeniya, Peradeniya.
anoja11@gmail.com

Reddish-pink garnet sand is noticeable seasonally along the coast extending from Dickwella to Hambantota in the south and most parts of Sri Lanka's eastern coast.

In the present study, garnet sand is used as the raw material to manufacture a value added product namely, porous nanoparticles of iron yttrium oxide as it has a wide range of applications such as in magneto optical imaging, magnetic nanofilters and nano-abrasives, whereas at present, its applications are limited only to abrasives, sand blasting and water filtration. For the present study, the garnet samples were collected from Pulmoddai on the northeast coast of Sri Lanka. From X-ray powder diffraction (XRD) it was determined that the chemical composition of the used sample was $Fe_3Al_2Si_3O_{12}$ namely, almandine garnet.

In the method devised to synthesize porous iron yttrium oxide nanoparticles, 5g of hand sorted powdered garnet was reacted with 60mL of the 10M concentrated HCl at 90°C under reflux conditions. The refluxed solution filtered and 2% NaOH added to the filtrate until it reached to approximately pH 14 allowing iron hydroxides to precipitate and heated to 80°C to dissolve hydrated aluminum contents. The solution filtered and the precipitated iron oxides washed thoroughly with distilled water until free of NaOH, oven dried, dissolved in 10M HNO_3 and mixed with yttrium hexahydrate trinitrate solution according to the molar ratio $[Y^{3+}]$ / $[Fe^{3+}]$ = 3/5. The mixture poured into citric acid according to the molar ratio of [total cations] / [citric acid] = 1/1. The pH of the solution adjusted to 2 using aqueous ammonia and heated to 80°C until a light brown xerogel is formed. Later, this xerogel was calcined at 800°C in a muffle furnace for 2h to produce porous iron yttrium oxide nanoparticles. The synthesized compound was characterized using XRD, Fourier Transformed Infrared (FT-IR) spectroscopy and Scanning Electron Microscopy (SEM) techniques. XRD and FT-IR confirmed

the composition as $FeYO_3$ and the SEM confirmed it to be of porous structure with a nano range pore size of 100 nm.

Keywords: Iron yttrium oxide, garnet sand, almandine garnet, synthesized iron oxide