A Mössbauer Study of Scandium Oxide Doped Hematite
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Abstract
Scandium oxide-doped hematite, xSc2O3*(1-x)alpha-Fe2O3 with molar concentration x=0.1, 0.3, and 0.5 was prepared by using ball milling, taking samples at times 0, 2, 4, 8, and 12 hours. The resulting Mössbauer spectra of the nanoparticles systems were parameterized using NORMOS-90. For each concentration, the spectra at 0 hours only consisted of 1 sextet, as the substitution of Sc2O3 into Fe2O3 did not appear until after 2 hours of ball milling time (BMT). Concentration x=0.1 at BMT 2 hours consisted of 2 sextets while x=0.3 and 0.5 were fit with 1 sextet and 1 quadrupole-split doublet. Concentration x=0.1 at BMT 4 and 8 hours consisted of 3 sextets, and at BMT 12 hours consisted of 4 sextets. For concentrations x=0.3 and 0.5 at BMT 4, 8, and 12 hours the spectra were fit with 3 sextets and 1 quadrupole-split doublet. With increasing initial concentration, the appearance of the quadrupole-split doublet became more pronounced, indicating the substitution of Fe into Sc2O3 occurred. But for x=0.1, the BMT did influence the number of sextets needed, causing an increase in substitution of Sc2O3 into Fe2O3.

Motivation
To determine the possibility of creating scandium oxide doped hematite nanoparticles by mechanical means. This will open new studies of scandium oxide’s properties and other applications.

Mössbauer Spectroscopy
Scandium oxide doped nanoparticles were exposed to a Cobalt 57 emitting gamma radiation. The intensity of the gamma ray beam is then plotted with respect to the particle’s source velocity. This is the Mössbauer spectra, and is used to analyze the collected data.

Ball Milling
This machine is used to produce the nanoparticles used in this experiment. This machine grinds particles with metal balls to induce a mechanochemical reaction in the hematite. The times of 0, 2, 4, 8, and 12 hours were used to create the samples for data collection.

Conclusion
Ball milling was used to induce a mechanochemical reaction in which scandium and iron ions were substituted in the solution. The Mössbauer Spectra confirms this, as increasing the ball milling time increased the amount of sextets and doublets needed for an accurate fit. This data proves the creation of nanoparticles from Scandium Oxide doped hematite.

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