

Mössbauer Spectroscopic Study of Fe₂O₃ Nanoparticles Dispersed over a Silica Matrix

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Z. Naturforsch. **54 a**, 513–518 (1999); received June 28, 1999

A series of Fe₂O₃-SiO₂ nanocomposites (9 - 33 wt% of Fe₂O₃) has been prepared by a sol-gel method and submitted to thermal treatments at 300 - 900 °C. The samples were characterized by X-ray diffraction and Mössbauer Spectroscopy measurements. Superparamagnetic behavior is exhibited by all the samples, indicating that the size of iron oxide grains is in the nanometer range (4 - 6 nm). Increase of iron content and temperature treatment give rise to a small particle growth, while the spread of sizes around the average value increases with the iron concentration. The Mössbauer spectra, at all the explored compositions, show a very steep increase of the peak width by treatment temperature at 900 °C, indicating the formation of the ferrimagnetic γ -Fe₂O₃ phase from the antiferromagnetic amorphous Fe₂O₃ phase, which dominates in the samples treated at lower temperatures. The samples at 28.5% and 33.2%, treated at 900 °C, also show a component of γ -Fe₂O₃ in the blocked state at room temperature. Moreover, the growth of the particles favours the formation of other oxide phases (α and ε phase) along with the γ phase.

Key words: Nanocomposite; Ferric Oxide; Mössbauer Spectroscopy; X-ray Diffraction.