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Mossbauer spectroscopy and neutron diffraction study of the mechanosynthesis of nanocrystalline MgFe2O4

Nanosized spinel-type ferrites are key materials for advancements in electronics, magnetic storage and ferrofluid technologies as well as bio-inspired applications. Magnesium ferrite, MgFe2O4, is an important member of the spinel family: apart from its extensive magnetic and electronic applications, it is used in heterogeneous catalysis and adsorption, and sensor technology. Mechanosynthesis is a powerful method for the production of novel, high-performance, and low-cost nanomaterials [1]. The evolution of nanocrystalline MgFe2O4 by high-energy milling a mixture of MgO and alpha-Fe2O3 has been investigated by Mössbauer spectroscopy and X-ray powder diffraction [2]. High resolution TEM has confirmed the ordered nature of the inner core of nanoparticles surrounded by a disordered surface shell/interface region as concluded from analyses of zero and applied field spectra [2]. Neutron diffraction measurements have been carried out (SPODI, FRM-II) on a series of 7 samples of MgO and alpha-Fe2O3 milled for periods of 0.25 h to 12 h. This has enabled details of the transformation of the initial crystalline MgO and Fe2O3 phases via intermediate states to the final nanocrystalline mechanosynthesised MgFe2O4 product to be investigated. A comparison of the findings from the complementary Mössbauer effect and neutron diffraction studies will be presented. References [1] V. V. Boldyrev, Russ. Chem. Rev. 75 (2006) 177. [2] V. Šepelák, A. Feldhoff, P. Heitjans, F. Krumeich, D. Menzel, F. J. Litterst, I. Bergmann, K. D. Becker, Chem. Mater., 18 (2006) 3057

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Summary

The evolution of nanocrystalline MgFe2O4 by high-energy milling a mixture of MgO and alpha-Fe2O3 has been investigated by Mössbauer spectroscopy, Neutron and X-ray powder diffraction. This has enabled details of the transformation of the initial crystalline MgO and Fe2O3 phases via intermediate states to the final nanocrystalline mechanosynthesised MgFe2O4 product to be investigated.

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