The structural and magnetic properties of a γ-Fe_2O_3 nanopowder synthesized by atmospheric microwave torch

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For the synthesis of γ-Fe_2O_3 nanoparticles a microwave torch discharge ignited in Ar at atmospheric pressure has been used. A double-walled nozzle electrode enabled us to introduce separately the gases: Ar flowed in the central channel whereas the mixture of H_2/O_2 and $Fe(CO)_5$ vapour was added into the Ar discharge through the outer channel. The composition and properties of the synthesized nanopowders were studied by TEM, XRD, Raman and Mössbauer spectroscopies. For the magnetic measurements in the range 293–1073 K a vibrating sample magnetometer was employed. Heat capacity and ZFC/FC measurements were perfomed on a PPMS® device from Quantum Design.
Only the cubic γ-Fe_2O_3 phase with the mean crystallite size of 20 nm was identified by XRD in a representative sample. The total spectrum area (TSA) of the Mössbauer transmission spectrum measured on the sample in the range 4–293 K strongly decreased with increasing temperature ($TSA = 0.155$ at 5 K, $TSA = 0.026$ at 293 K). This behaviour is attributed to a bimodal particle size distribution and the chain-like morphology of very small particles (observed under TEM), which enables tilting motions of particles. We also present the high-temperature magnetic properties of the repesentative sample and describe its structural changes and phase transformations up to 1073 K.

9.7 cm

13.4 cm

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