

# Magnetic resonance and Mössbauer studies of superparamagnetic $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles encapsulated into liquid-crystalline poly(propylene imine) dendrimers

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## Abstract

We present the first results of electron magnetic resonance (EMR) and Mössbauer spectroscopy studies of  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles (NPs) incorporated into liquid-crystalline, second-generation dendrimers. The mean size of NPs formed in the dendrimers was around 2.5 nm. A temperature-driven transition from superparamagnetic to ferrimagnetic resonance was observed for the sample. Low-temperature blocking of the NP magnetic moments has been clearly evidenced in the integrated EMR line intensity and the blocking temperature was about 60 K. The physical parameters of magnetic NPs (magnetic moment, effective magnetic anisotropy) have been determined from analyses of the EMR data. The effective magnetic anisotropy constant is enhanced relative to bulk  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> and this enhanced value is associated with the influence of the surface and shape effects. The angular dependence of the EMR signal position for the field-freezing sample from liquid-crystalline phase showed that NPs possessed uniaxial anisotropy, in contrast to bulk  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>. Mössbauer spectroscopy determined that fabricated NPs consisted of an  $\alpha$ -Fe core and a  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> shell. Copyright © 2011 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

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## Keywords

dendrimers, EPR spectroscopy, Moessbauer spectroscopy, nanoparticles, polymers