Mössbauer Measurement on Silica-Supported Magnetite Tubes

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Introduction

The formation of inorganic tubular structures has attracted much interest in recent years, owing to their unusual physicochemical properties and potential applications [1]. In this work, we describe a Mössbauer study on silica-supported magnetite tubes. These millimeter-size tubes were formed in experiments that tightly control the tube radius and growth speed [2].

Experimental

Mössbauer spectra were recorded in the constant acceleration mode at temperatures ranging from 4.2 K to 300 K on a See Co spectrometer of the EMR facility.

Results and Discussion

The room-temperature spectra (**Figure 1**) showed a quadrupole doublet with an isomeric shift of 0.34 mm/s and quadrupole splitting 0.72 mm/s, indicating no magnetic ordering. A hyperfine sextet was observed below 100 K, whose contribution to overall intensity increased with further temperature lowering. The spectrum at 4.2 K was a mixture of two hyperfine sextets characterized by the magnitudes of the isomer shift (IS), quadrupole splitting (QS) and internal magnetic field of 0.46 mm/s, 0.02 mm/s, 51.2 T and 0.45 mm/s, 0.04 mm/s, 47.5 T, respectively. The intensity ratio of the two species was 1.22. A low-intensity doublet spectrum (about 5% of the total) with IS = 0.46 mm/s and QS = 2.52 mm/s was also present.

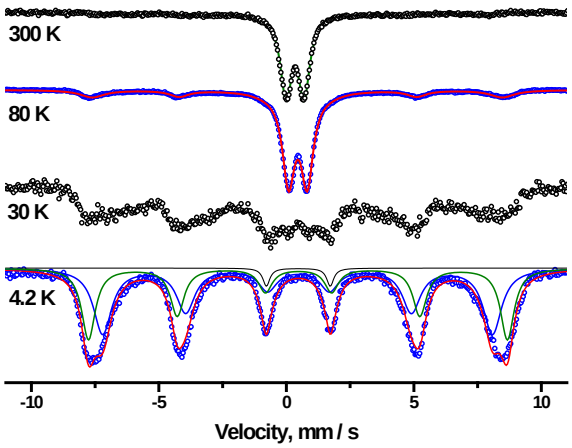

Figure 1. Mössbauer spectra recorded at temperatures indicated. Open circles are the experimental data and the solid lines were calculated with parameters given in the text. In the 4.2 K spectrum, the green, blue and black lines represent the two simulated sextets and one doublet, while the red line is the sum of all three.

Conclusions

The appearance of the hyperfine splitting in the low-temperature Mossbauer spectra indicates magnetic ordering. Small differences in the Mössbauer parameters of the bulk magnetite and the tubes studied here hint towards formation of non-stoichiometric magnetite phases. [2]

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References

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[2[Makki, R., *et al*., J. Am. Chem. Soc., **134**, 15519-15527 (2012).