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# Grain Size and Field Dependence of the Morin Transition and Mössbauer Spectroscopy of Synthetic Hematite

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Hematite is a common magnetic mineral occurring in sediments, both in detrital and authigenic form. The dependence of its magnetic properties on grain size and particle surface are not yet fully understood. Here we present a systematic investigation of magnetic properties of synthetic hematite particles (14 nm, 22 nm, 34 nm, 147 nm, 11 $\mu$m) across the so-called Morin transition, focusing on the transition temperature and amplitude, transition hysteresis, and defect moment remaining in the antiferromagnetic phase below the transition temperature.

While hysteresis parameters above and below the Morin transition did not show well-defined systematic grain size trends, we found a clear relation between grain size, applied field, and transition temperature along with results shown by previous studies. The field dependence of the transition was found to be stronger in smaller particles.

We measured Mössbauer spectra at room and low temperatures, finding a clear grain size dependence of Mössbauer parameters. We also found a second sextet in the smallest particles, whose relative contribution is inversely proportional to the size of the sample.

The hyperfine field - the magnetic field at the $Fe^{3+}$ atom in the lattice - decreases with decreasing grain size. We also found a linear correlation between the transition temperature and the magnetic hypefine field.