SUPERPARAMAGNETIC PROPERTIES OF Fe_2O_3 PARTICLES: MÖSSBAUER SPECTROSCOPY AND DC MAGNETIC MEASUREMENTS

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When studying magnetic systems consisting of particles with sizes in the nanometer range, the principal problems is the nature of their magnetic state. At low temperatures they are typically mictomagnetic or spin-glass like and with increasing temperature they gradually go over to the superparamagnetic state. It is necessary to realize, however, that the temperature of transition to superparamagnetism strongly depends on the relevant time window which amounts to ~10^{-7} s for Mössbauer spectroscopy of ^{57}Fe and units of seconds for d.c. magnetic measurements.

The particles in our powder samples of Fe oxide were shown by SEM to have sizes in the range of 10 nm. Their Mössbauer spectra (MS) were acquired in a Janis cryosystem in the temperature range 120-295 K. In contrast to XRD, where the phase composition could not be unambiguously resolved, MS at 120 K clearly indicated the absence of magnetite and presence of the maghemite phase. The magnetization curves were measured in the same temperature region in fields up to 5 T. In addition the temperature dependences of magnetic moments of Zero-Field-Cooled and Field-Cooled samples for various probe fields were analyzed. The derived distributions of blocking temperatures will be compared with our results from Mössbauer spectroscopy.