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Iron Nanoparticle Mössbauer Spectroscopy with Rare-Earth Permanent Magnets L.D. SWAFFORD, C.G. PARIGGER, H.-Y. HAH, S. GRAY, M. COLE, D. WARNBERG, C.E. JOHNSON, J.A. JOHNSON, University of Tennessee Space Institute, Tullahoma, TN, USA, E. SHAFRANOVSKY, Russian Academy of Sciences, Moscow, RU — Properties of materials can be determined with a high degree of precision from Mössbauer spectra. Due to the recoil energy of free particles, Mössbauer spectroscopy is useful when the atoms are contained in a lattice structure. Resonance with the nucleus is achieved using gamma radiation. The Doppler effect is utilized by oscillating the radiation source thus modulating the energy of the gamma radiation. The recorded spectra show hyperfine splitting with intensities that depend on the angle of the gamma radiation with respect to the nuclear spin moment. For ferri- and ferro-magnets, the orientation of the magnetization and strength of the applied field can be inferred. For most paramagnets the magnetic susceptibility is on the order of 10^{-6}, and application of Mössbauer spectroscopy requires low (a few Kelvin) temperature and large (a few Tesla) magnetic fields that are usually generated with superconducting magnets. However, for single-domain nanoparticles, or super-paramagnets, with susceptibility on the order of 10^{-1} to 10^{-2}, a sizeable magnetization can be produced at room temperature in 1 Tesla fields. Such magnetic fields are obtainable with Nd-Fe-B permanent magnets. We present results of recent measurements on nanoparticles of iron.

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