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Size effect of magnetoferritins and its implications

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Ultrafine-grained magnetites have been found in numerous geological samples and even extraterrestrial samples; therefore, they are of great interests in rock and mineral magnetism, environmental magnetism and paleomagnetism. The ultrafine-grained magnetites also have great application in biomedicine including iron oxide contrasts of magnetic resonance imaging in early detection of tumors. Ferritin-based ultrafine-grained magnetites can be taken as ideal sample for study of superparamagnetism, because of controllable and uniform grain size, monodispersity, lacking of magnetic interaction, good availability, and "ideal" superparamagnetic behaviors at room temperature. Here, we characterized magnetic properties of magnetoferritin nanoparticles (named as M-HFn naoparticles) that were bio-mimetically synthesized by using human H-chain ferritins. These M-HFn nanoparticles contain magnetite cores with different mean sizes, ranging from 2.7±0.6 nm to 5.6±1.4 nm, in intact protein shells. Low-temperature magnetic property measurements, including hysteresis loops, temperature-dependence of magnetization, and frequency-dependent ac susceptibility, showed that the coercivity, saturation magnetization and blocking temperature are sensitive to grain sizes of magnetite cores in the M-HFn nanoparticles. This provides further clues for identifying superparamagnetic magnetite in geological samples. Moreover, we found that the relaxivity and peroxidase-like activity of the M-HFn nanoparticles are size-dependence of magnetite cores, which suggests that magnetoferritins with different core sizes can enhance performance in cancer detection by magnetic resonance imaging and visualizing tumor tissues by immeunohistochemical staining.