Abstract Submitted
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Magnoelastic coupling in magnetic oxide nanoparticles[1] QI SUN, University of Tennessee, SHEILA BAKER, University of Missouri-Columbia, CHRISTINA BIRKEL, RAM SESHADRI, University of California at Santa Barbara, WOLFGANG TREMEL, Johannes Gutenberg-Universitat, ANDREW CHRISTIANSON, Oak Ridge National Laboratory, JANICE MUSFELDT, University of Tennessee — Phonons are exquisitely sensitive to finite length scale effects in a wide variety of materials. To investigate confinement in combination with strong magnetoelastic interactions, we measured the infrared vibrational properties of MnO and $CoFe_2O_4$ nanoparticles and their parent compounds. For MnO, a charge and bonding analysis reveals that Born effective charge, local effective charge, total polarizability, and the force constant are overall lower in the nanoparticles compared to the bulk. We find that the spin-lattice coupling drops from $\sim$7 cm^{-1} in the single crystal to $<$1 cm^{-1} in the nanoparticles. For $CoFe_2O_4$, the spectroscopic response is sensitive to the size-induced crossover to the superparamagnetic state, which occurs between 7 and 10 nm, and a spin-phonon coupling analysis supports the core-shell model. Moreover, it provides an estimate of the thickness of the magnetically disordered shell, increasing from 0.4 nm in the 14 nm particles to 0.8 nm in the 5 nm particles, demonstrating that the associated local lattice distortions take place on the length scale of the unit cell. These findings are important for understanding finite length scale effects in magnetic oxides and other more complex functional oxides.

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