Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Raman scattering studies of the temperature- and magnetic field-dependent studies of the single molecule magnet Mn_{12}-acetate[1] SHI YUAN, YEWON GIM, S.L. COOPER, University of Illinois — Single molecule magnets (SMMs) have attracted much interest since they were first reported in 1991. SMMs are a class of metal-organic compounds that show superparamagnetic behavior below a certain blocking temperature at the molecular scale. We present a study of the temperature- and magnetic-field-dependence of the single molecule magnet Mn_{12}-acetate using Raman scattering. Temperature-dependent measurements show an anomalous phonon behavior near 200K, indicating a lower crystal symmetry than tetragonal and supporting the inclusion of a second-order rhombic term $E(S_x^2 - S_y^2)$ in the Hamiltonian, consistent with previous neutron and X-ray studies. Our field-dependent measurements near 3K show that a magnetic field oriented perpendicular to the Mn_{12} magnetization direction does not affect the phonon vibrational energies. However, when the magnetic field is oriented along the easy-axis direction, there is a clear phonon mode splitting at 540 cm^{-1}, indicating a strong spin-phonon coupling associated with this phonon mode and the existence of a fourth-order anisotropy term in the Hamiltonian for Mn_{12} acetate. The field-induced nonzero local transverse term may be responsible for a small tilt of the anisotropy axis and the odd resonance tunneling.

[1]Research was supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering under Award DE-FG02-07ER46453

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Date submitted: 13 Nov 2013 Electronic form version 1.4