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Structural and magnetic investigations of single-crystalline neodymium zirconate pyrochlore Nd₂Zr₂O₇

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Abstract

© 2015 American Physical Society. We report structural and magnetic properties studies of large high-quality single crystals of the frustrated magnet Nd₂Zr₂O₇. Powder x-ray diffraction analysis confirms that Nd₂Zr₂O₇ adopts the pyrochlore structure. Room-temperature x-ray diffraction and time-of-flight neutron-scattering experiments show that the crystals are stoichiometric in composition with no measurable site disorder. The temperature dependence of the magnetic susceptibility shows no magnetic ordering at temperatures down to 0.5 K. Fits to the magnetic susceptibility data using a Curie-Weiss law reveal a ferromagnetic coupling between the Nd moments. Magnetization versus field measurements show a local Ising anisotropy along the 111 axes of the Nd³⁺ ions in the ground state. Specific heat versus temperature measurements in zero applied magnetic field indicate the presence of a thermal anomaly below $T \sim 7$ K, but no evidence of magnetic ordering is observed down to 0.5 K. The experimental temperature dependence of the single-crystal bulk dc susceptibility and isothermal magnetization are analyzed using crystal field theory and the crystal field parameters and exchange coupling constants determined.

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