First Observation of the Spin Ice State in a Spinel Structure

aInstitute of Physics, POB 304, HR-10 000 Zagreb, Croatia
bDepartament of Inorganic Chemistry, Univ. del Pas Vasco, 48080 Bilbao, Spain
cKazan State University, 420008 Kazan, Russia
dDepartamento CITIMAC, Fac. Ciencias, Univ. de Cantabria, 39005 Santander, Spain
eDipartimento di Chimica Fisica M. Rolla, Universit di Pavia, V.le Taramelli 16, I-27100 Pavia, Italy
fInstitut Nanosciences et Cryognie, Commissariat à l’énergie atomique/Direction des sciences de la matière, 38054 Grenoble, France

Spin ice systems have so far been observed exclusively in pyrochlore systems, Ho$_2$Ti$_2$O$_7$ and Dy$_2$Ti$_2$O$_7$ being the most studied examples. Spinels, with a general formula AB$_2$X$_4$, exhibit a sublattice of octahedrally coordinated $B$ ions that is identical to the pyrochlore lattice in titanates. We have performed an extensive investigation of the spinel compound CdEr$_2$Se$_4$ and found a clear signature of the spin ice state. The entropy recovered in magnetic field corresponds to (R/2)ln(3/2) (= entropy of the proton disorder in water ice), the magnetization at low temperature saturates at half of the value of the magnetic moment and the susceptibility drops to zero below the freezing temperature. Due to the different local environment of the erbium ion in the spinel structure, single-ion anisotropy is altered and calculations show that it acquires the needed Ising character. We will compare our results with the pyrochlore compounds.

Subject category:
2. Quantum and Classical Spin Systems

Presentation mode:
oral

Corresponding author:
I. Živković

Address for correspondence:
Institute of Physics
POB 304
HR-10000 Zagreb, Croatia

Email address:
zivkovic@ifs.hr