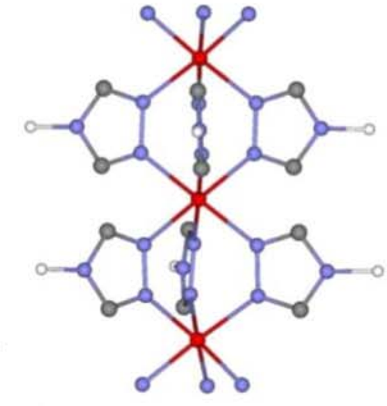
Crystal Orientation Imaging of Organic Nanomagnets

Organic nanomagnets are lighter than conventional magnets and need new techniques for structure characterization

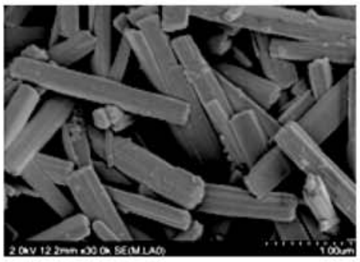
[Fe(Htrz)$_2$(trz)].BF$_4$



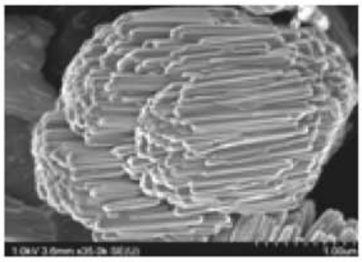
nanomagnet material

The development and characterization of nanometer-scaled functional molecular-based materials, which may exhibit fascinating magnetic, optical or electrical properties, have recently attracted much attention. Molecular nano-objects offer the possibility of tuning or combining these properties by a rational synthetic chemical approach. These materials present promising technological applications in molecular electronics, or magneto-optic memory devices providing that we can design single domain particles with hysteresis behaviour in the future.

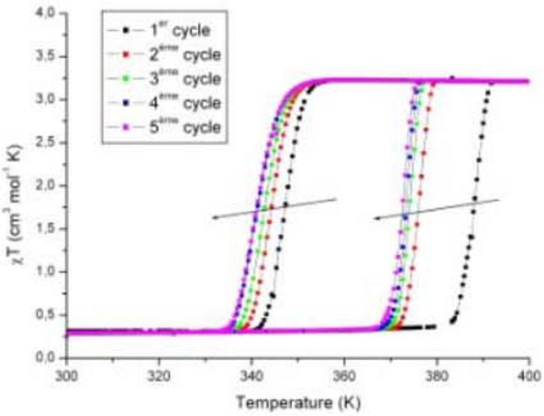
Nanorods of the spin crossover material [Fe(Htrz)$_2$(trz)].BF$_4$ are prepared by arrested growth within liquid crystal phases. A complete understanding of the crystal growth requires the identification of the orientation of the crystal axes with respect to the morphology of the nanoparticles.

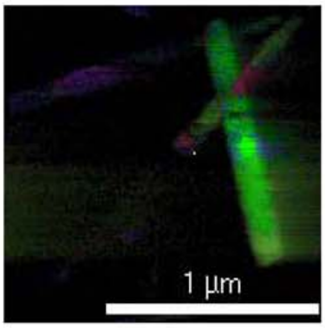


The intrinsic physical properties (magnetic and optical hysteresis) rely on the domain structure of the nanoparticle. Molecular nanoparticles of [Fe(Htrz)$_2$(trz)].BF$_4$ are extremely sensitive to the e-beam so that ASTAR at high frame rate is the only possible technique which allows the recording of the diffraction pattern before the destruction of the probed nanoparticle occurs.



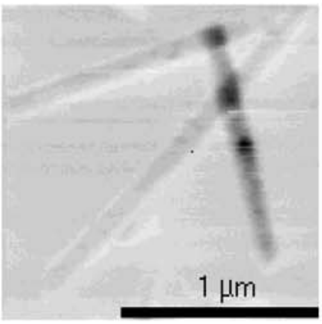
The challenge:	Identify if nanocrystals diffract and whether they are single crystal particles / mapping of the unit cell disorientation along the nanoparticle.
Solution:	ASTAR technique at high frame rate >100 fps, no cryo-holder is used

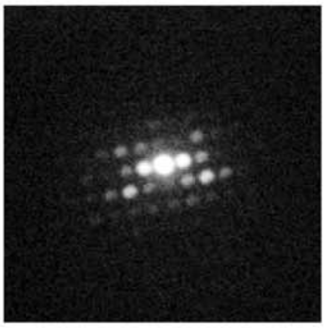




Experimental Data

TEM type: Jeol 3010
Map resolution: 10 nm
Scanned area: 2 x 2 µm





Crystal Structure

Orthorhombic, Cmcm
a = 9.37 Å, b = 17.05 Å
c = 7.34 Å

A complete mapping of the diffraction pattern on a single nanoparticle shows that the particle is almost single domain, and that the disorientation of the crystal lattice is limited to only 5%. ASTAR also shows that the disorientation is not progressive, but rather restricted to

D. Mader et al *Journal of Dispersion Science and Technology* 32 (2011)