14 T Cryo-Magnet for X-ray Magnetic Circular Dichroism

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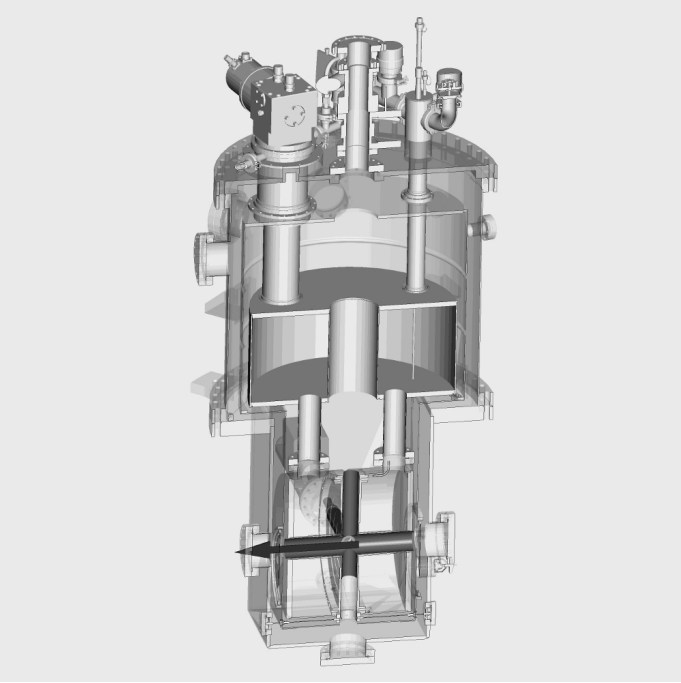
We report on design, construction and performance of a 14 T cryo-magnet for x-ray magnetic circular dichroism (XMCD). This end station has been installed on the Beamline for Advanced Dichroism Experiments (BLADE) at the Diamond Light Source. BLADE is a soft x-ray beamline that can deliver photon beam with energy from 400 eV to 1.6 keV. This energy range covers absorption edges of 3d transition metals and rare earth elements and the beamline is optimized for studies of magnetic materials.

A magnetic field along the horizontal direction is delivered by a superconducting split pair coil. The field intensity can be fully reversed within 1 hour. The magnet vessel and sample are kept in ultra-high vacuum. The sample is connected to the variable temperature insert which allows the control of the temperature within the range of 2.5 - 420 K. The VTI can be replaced by a 3He "Heliox" insert. The sample temperature range accessible with the Heliox insert is 0.5 – 350 K. Sample with the insert rotates around its vertical axis which can be used to study magnetic anisotropy.

X-ray absorption can be detected by total electron yield and fluorescence yield. Soft x-rays are strongly absorped in matter which gives this technique very high sensitivity and therefore is suitable for studying magnetic nanostructures. The system allows to study the magnetic moment as a function of temperature, magnetic field (element sensitive magnetization curves) or angle.

The magnet system has been successfully tested and routinely used since 2012. An example of experiment will be presented. In future, the magnet system will be extended with a UHV preparation chamber equipped with a nanocluster deposition source. This chamber will be available for in-situ preparation of magnetic nanostructures.



A section through the 14T magnet.