MT29 Abstracts and Technical Program



Contribution ID: 553

Type: Poster

Fri-Af-Po.07-02: Miniature split-pair coil for x-ray measurements at the European X-Ray Free-Electron Laser Facility

Friday 4 July 2025 14:00 (2 hours)

We introduce a miniature pulsed magnetic field setup and a sample cryostat that is available at the European XFEL user facility for x-ray beamtimes. It is installed at one of the six beamlines called Materials, Imaging and Dynamics that uses femto-second x-ray pulses of extreme brilliance to study ultra-fast dynamics of magnetic materials and nano-structures [1].

We describe the experimental setup that uses an in-house built split-pair coil cooled directly by liquid nitrogen to provide a magnetic field of up to 15 T. A sample cryostat allows solid-samples to be studied in vacuum at cryogenic temperatures from 10 K to 300 K in the bore of the magnet. The magnet design allows for a wide angular diffraction of x-rays on a sample by incorporating a large horizontal slit. The unique structure of x-rays at the Eu-XFEL has a burst of duration 600 μ s made up of 2700 ultra-short x-ray pulses. The magnetic field pulse has a rise-time of 500 μ s which, when overlaid with the x-ray burst, allows single x-ray pulses to probe the sample over the complete magnetic field range, greatly increasing the duty cycle of the available x-ray pulses in the presence of a magnetic field.

We describe the integration of the setup at the beamline including power source, magnet cryostat, sample cryostat, sample exchange and sample alignment. Finally we report on commissioning and performance of the setup for x-ray experiments.

[1] A. Madsen et al. "Materials Imaging and Dynamics (MID) instrument at the European X-ray Free-Electron Laser Facility" J. Synchrotron Rad. 28, 637-649 (2021)

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Session Classification: Fri-Af-Po.07 - High Field Pulsed Magnets II