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A Miniature Split-Pair Coil Sample Environment at the Materials Imaging and Dynamics Instrument of the European XFEL

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The MID instrument at the European XFEL uses hard X-ray FEL beam to study material dynamics on solid-state systems [1]. We introduce a miniature pulsed magnetic field setup and a sample cryostat that can be installed at the MID interaction chamber to allow an applied magnetic field up to 15 T and sample temperature control from 10 K to 300 K on fixed solid targets. The split-pair coils of the magnet are suited to studying single-crystal diffraction and magnetic scattering in the horizontal scattering plane where tuning magnetic field and temperature can be used to establish a thermodynamic state or to probe a phase transition. The duration of the magnetic field pulse is ~ 1 ms and chosen to overlap with the 0.55 ms long FEL pulse-train to make best use of the FEL beam. A useful aspect of the setup is operation without the need for X-ray windows. We describe the integration of the setup at the MID instrument with the technical challenges that were faced. Commissioning of the setup was completed and has demonstrated the setup performance for user beamtimes at the MID instrument.

A recent upgrade of the miniature pulsed magnetic field setup has been to allow X-ray Photon Correlation Spectroscopy (XPCS) and Coherent X-ray Diffraction Imaging (CXDI) on micrometer-sized samples. This requires stability in sample position also on the order of the sample size and minimization of sample vibrations introduced from the rapidly changing magnetic field pulse. We use laser interferometry to characterize the setup stability and performance.

[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)

I plan to submit also conference proceedings

No

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