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Materials Imaging and Dynamics Instrument at the European XFEL

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The unique properties of hard X-ray laser beams generated by the European XFEL will enable completely new experiments in materials science. In particular, the Materials Imaging and Dynamics (MID) station will offer extended capabilities for scattering and imaging experiments, e.g. coherent X-ray diffractive imaging (CXDI) and X-ray photon correlation spectroscopy (XPCS), compared to present state-of-the-art facilities. Based on the high degree of coherence, the exceptional flux, and the ultra-short pulses of the X-ray laser it will be possible to investigate materials with unprecedented resolution in space and time [1].

The X-ray energy at MID will be in the range of 5 to 25 keV either using the full SASE spectrum ($\Delta E/E \approx 2^{*}10\text{-}3$), using the seeded beam ($\Delta E/E < 10\text{-}4$), or filtered by the use of monochromators (Si(111) & Si(220)). The use of CRL transfocator or a nanofocus setup enables beam sizes down to a few micrometers and 10th of nanometers, respectively.

Allowing a broad variety of different dynamical investigations, MID will be equipped with an optical pump laser system as well as with a pulsed magnet module in order to measure the response of various materials after external excitation. Furthermore, a Split and Delay Line (SDL) can be used to split single FEL pulses into two and delay them with respect to each other. By this, an X-ray pump / X-ray probe scheme as well as dynamical investigations in the sub-ps time range will be possible.

The MID instrument provides a multitude of different detector systems, such as the AGIPD (adaptive gain integrating pixel detector), depending on the experimental requirements. The data acquisition system will collect - beside the recorded X-ray scattering pattern - also the shot-to-shot beam parameter (e.g. spectrum, intensity) in a dedicated diagnostic endstation enabling widespread possibilities for an optimal data treatment.

[1] A. Madsen, J. Hallmann, T. Roth, G. Ansaldi, Technical Design Review: Scientific Instrument MID , 2013.

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