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Spatially resolved ultra-fast magnetization dynamics tracked via resonant magnetic scattering at FLASH

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Free-electron laser (FEL) sources based on self-amplified spontaneous emission can provide intense and ultra short femtosecond x-ray pulses from the vacuum ultraviolet to the x-ray range. The unique combination of short pulselength and short wavelength allows to investigate a number of dynamic phenomena on otherwise inaccessible scales.

One of the forefront problems in modern magnetism research, namely ultra-fast demagnetization, related to non-equilibrium magnetization dynamics and manipulation of the magnetic state on ultra-fast time scales, can be addressed with the possibilities of these new sources [C. Gutt, et al., PRB, 79 212406 (2009), C. Gutt, et al., PRB 81, 100401(R) (2010).]. Here results of an optical IR-pump–FEL-probe experiment on a ferromagnetic Co/Pt multilayer with perpendicular magnetic anisotropy are shown. The optically induced ultra-fast demagnetization dynamics have been measured with resonant x-ray small angle scattering element specific at the Co M-edge allowing for simultaneous observation of the local magnetization and the characteristic length scale of the domains via the x-ray magnetic circular dichroism (XMCD) effect.

The experiments were performed at the FLASH facility at DESY in Hamburg.

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