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# Femtosecond time-resolved and element-specific x-ray absorption spectroscopy of Fe/MgO

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A localized optical excitation of a metal/insulator heterostructure induces ultrafast dynamics in its individual compounds, which can involve charge and spin transfer processes as well as coupling to low energy excitations mediated by e.g. electron-electron and electron-phonon scattering. Femtosecond soft x-ray spectroscopy facilitates to separate and identify these electronic and lattice excitations directly in the time domain and, furthermore, is sensitive to the dynamics of the individual constituents itself due to its element-specific character. We have measured time- and element-resolved x-ray absorption spectroscopy of a [2nm Fe/2nm MgO]8 multilayer at the Fe -- and O -- edges with a time resolution of 150 fs. After optically exciting locally Fe with a UV laser pulse of 266 nm wavelength we see a clear pump-induced effect at both edges in fs time resolution. The Fe-signal shows an ultrafast 0.5% dropdown of the signal in 240 fs, followed by a recovery on a 1 ps timescale, while O reaches its maximum not until 1 ps. This slower response suggests that the energy transfer from the metal to the insulator is mediated by phonons, or a combined electronic-phononic process rather than by a direct charge transfer excitation.

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