Distinct Ni and Fe Signatures in $Ni_{1-x}Fe_x$ Hysteresis Revealed by Femtosecond XUV Spectroscopy

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Abstract. We demonstrate element-selective magnetization measurements in Ni_xFe_{1-x} alloys using femtosecond laser-driven high-order harmonic generation (HHG) in the extreme-ultraviolet (XUV) spectral range (40 -72 eV). By employing transverse magneto-optical Kerr effect (T-MOKE) spectroscopy near the Ni and Fe *M*-edges, we recorded element-resolved magneto-optic hysteresis loops for $Ni_{0.8}Fe_{0.2}$, $Ni_{0.5}Fe_{0.5}$, and $Ni_{0.2}Fe_{0.8}$ alloys. Distinct spectral asymmetries corresponding to Ni and Fe contributions reveal composition-dependent shifts of the *M*-edges and stoichiometry dependent response at the corresponding resonant energies. Despite the distinct magnetic responses od different alloys, both Ni and Fe exhibit nearly identical coercive fields within the same alloy, indicating strong exchange coupling between the elemental magnetic moments. Our results show that HHG based element specific femtosecond XUV spectroscopy provides unique insight into magnetization dynamics in transition-metal alloys.