

Chapter 1

From Magnetodynamics to Spin Dynamics in Magnetic Heterosystems

Claus M. Schneider

Abstract The dynamic behavior of magnetic systems covers a broad range of length and time scales and is of both fundamental interest and technological relevance. The particular challenge in magnetic heterosystems is the need to disentangle the responses of the individual magnetic and chemical components. In this contribution we discuss the results of two complementary experimental approaches addressing element-selective magnetization and spin dynamics. Time-resolved X-ray photoemission electron microscopy (TR-XPEEM) is employed to image the temporal evolution of the magnetization in interlayer exchange-coupled trilayers in the picosecond regime with high lateral resolution. In order to address the femtosecond time scale with element selectivity, we developed a novel pump-probe magneto-optical Kerr effect (MOKE) technique involving higher harmonic generation (HHG) in the extreme ultraviolet regime. We are able to map the spin dynamics of the individual constituents in Permalloy ($\text{Ni}_{80}\text{Fe}_{20}$) with a time resolution of better than 100 fs. Combining PEEM with HHG excitation may pave the way to an element-selective magnetic imaging technique in the lab offering femtosecond time resolution.

1.1 Introduction

The dynamic behavior of magnetic systems involves a wide variety of physical phenomena and covers a broad range of time scales of more than 23 orders of magnitude. Moreover, this enormous dynamic range is also of high technological relevance. The long-term end of the time axis is marked by the data storage retention time defined by the magnetic storage industry. It relates to the thermal stability of a written bit of information for a period of at least 10 years. Another technologically important regime is located between 10^{-9} and 10^{-12} s and governs fast magnetic

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Magnetoelectronics And Magnetic Materials novel Phenomena And Advanced Characterization Proceedings

Katrin Zwirgmaier



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