

Ultrafast Magnetization Dynamics in NiCo Thin Films Presenting Weak Stripes Domains

J D DUBOIS^{1,2}, B V VODUNGBO², M H HENNES³, G L LAMBERT², E J JAL², R D DELAUNAY², AND F V VIDAL³

¹*LOA ENSTA / Ecole Polytechnique , Paris, France*

²*LCPMR, Sorbonne Université, Paris, France*

³*INSP, Paris, France*

Contact Email: juliette.dubois.loa@ensta-paris.fr

Recently, all optical switching has emerged as a powerful technique to drive the magnetization of thin films. We are trying to adopt such an all-optical strategy to control the magnetization state of magnetostrictive nanowires grown inside a photostrictive matrix. The first step is to investigate the demagnetization of thin films of a nickel rich ($> 80\%$) cobalt nickel alloy that will compose the nanowires. The femtosecond magnetization dynamics has already been studied in several ferromagnetic alloys and multi-layers such as iron-nickel or cobalt-platinum but there have been contradictory results concerning possible different demagnetization time or delays in the onset of the demagnetization of the different elements composing the system. Ultrafast demagnetization has not been studied so far with element selectivity in cobalt-nickel alloys and we hope to contribute to the development of a unified picture of this phenomenon in alloys. The sample we have studied is a 100 nm thick cobalt-nickel grown on a silicon substrate. Because of the magnetostriction of this alloy, a weak perpendicular magnetic anisotropy exists inside the thin layer. Therefore, above a threshold thickness, a magnetic structure consisting of alternating nanometric magnetic domains with out of plane component of opposite directions will appear. The structure will act as a diffraction grating for photon energies in resonance with the M absorption edges of cobalt (60 eV) and nickel (67 eV). We can then follow the intensity of the scattering spots for these energies as a function of the delay between the pump and the probe and thus reconstruct the magnetization dynamics of cobalt and nickel simultaneously. The preliminary results indicate that there is a delay of about 20 to 30 fs between the onset of demagnetization of cobalt and nickel and that the cobalt demagnetizes less than nickel.

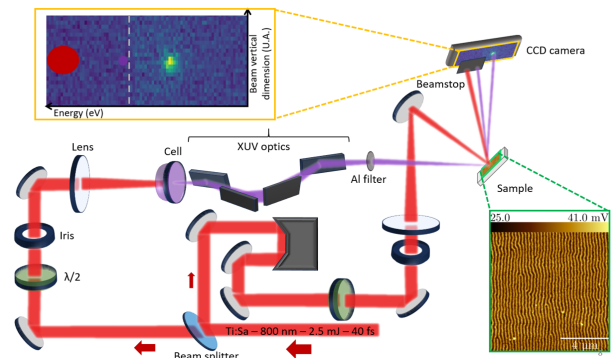


Figure 1: Top view of the pump-probe setup used to measured ultrafast magnetism dynamic – Down right: MFM image of NiCo sample were we can see the weak stripes magnetic domains – Top left: image of the first order of diffusion on the CCD camera