Ultrafast magnetization dynamics investigated with femtosecond laser pulses at Center of Lasers IPEN-CNEN: first results

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The investigation of ultrafast process in magnetic materials on the subpicossecond timescale is a subject of increased interest since pioneering work in the 90's showed that we can modify the magnetic properties of magnetic systems in femtosecond timescales, where the energy of the laser pulses is transferred to the electron system and the magnetization is decreased and taken out of equilibrium before the heating of the lattice[1] .While the mechanisms involved in the process of ultrafast demagnetization are still to be clarified, and the spin-orbit interaction seems to play a key role, these finding were confirmed by a variety of techniques like time-resolved two photon photoemission, time-resolved second harmonic generation and time resolved kerr and Faraday studies by many groups[2]. We setup an experiment in which the laser source is a Rainbow oscillator (Femtolasers) which is amplified at 1 kHz in an ODIN amplifier (Quantronix) to near infrared 40 fs laser pulses of hundreds of μJ energy (center wavelength around 800 nm). The input pulses are split in pump and probe pulses in which the pump pulses goes through an optical delay line. The pump pulse is doubled to 400 nm in a BIBO (BiB_3O_6) crystal and a static magnetic field ± 3 kOe is used along the experiments. In our configuration, we can measure simultaneously the electron and spin dynamics with time resolution limited by the duration of the pump pulse. We can probe the variation of the amplitude as well as the direction of the magnetization vector M and therefore to retrieve its trajectory from tens of femtoseconds up to 3 ns as detailed in a similar setup described in Ref.[3] and Ref.[4]. Here we will present our first results that concern the ultrafast magnetization dynamics of Co-rare earth doped films. Our focus is the investigation of the role of rare-earth doping in the ultrafast demagnetization and damping of the precession motion in transiction metals.Previous work have shown that these are promising systems for manipulating the ultrafast magnetization dynamics trough a material approach strategy [5]. [1] E. Beaurepaire, et. al, Phys. Rev. Lett. 76, 4250 (1996). [2] C. Stamm et. al., Nature Materials 6, 740, (2007). [3] Vomir et. al., Phys. Rev. Lett. 94, 237601, (2005). [4] J.-Y. Bigot et. al.Ultrafast Phenomena XIV, p. 316, Springer-Verlag, (2005). [5] S. G. Reidy et. al;, Appl. Phys. Lett. 82, 1254, (2003).