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Probe and control of low-power photo-excited magnetization precession in Co/Pd multilayer films

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Materials with Perpendicular Magnetic Anisotropy (PMA) are important in Magnetic Random-Access Memory (MRAM) devices due to their applications in perpendicular magnetic recording. Perpendicular magnetic recording provides advantages such as low noise and high thermal stability in MRAM devices. Therefore, it is important to understand the magnetization dynamics of systems with PMA. Co/Pd multilayer thin films have naturally high PMA due to strong d-orbital hybridization and magneto-elastic strain. Co/Pd systems have been studied extensively through the use of ultrafast optical pump-probe methods in order to measure the Time Resolved Photo-excited Precession of Magnetization (TRPEPM). TRPEPM relies on rapid changes in the effective field which is the sum of the demagnetizations field, anisotropy field, and external field. Most studies have been conducted at high laser fluence (> 1 mJ/cm2), where there is a rapid change in the demagnetization field, in order to study effects such as ultrafast demagnetization as well as the influence of Co and Pd thickness on precession. In this high laser fluence regime, these metallic systems are heated to their respective curie temperatures which could be a problem for practical magneto-optical memory devices. There has been little study on the low fluence regime (< 10 μJ/cm2) in these magnetic metallic systems, where there is an impulsive change in the anisotropy field which is composed of volume and interface components. In this study, we focus on three different Co/Pd systems with varying Co thickness from 0.4 to 0.74 nm all excited at varying pump fluence ranging between 0.42 to 3.14 μJ/cm2 to better understand the role of interface and volume components of anisotropy at low laser fluence regime.

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