Recent Advances in the Metrology of Magnetostriction of Ultrathin Films

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Magnetostriction, a material parameter particularly important to the recording head industry, has so far been predominantly assessed through the so-called optical cantilever method. This method is destructive, practically limited to silicon substrates, and of limited applied field capability of 100 Oe or so. A BH loop tracer that relies on the inverse magnetostriction effect and measures Delta_Hk, the change of the anisotropy field, Hk, under application of mechanical stress has, up to now, not been a true alternative because of its lower sensitivity. This was partially due to manually driven weights and wafer axial alignment, a method that was now replaced by an advanced design of automated axial alignment and pneumatic force control. Fig. 1 shows a direct comparison of free layer magnetostriction data from conventional spin valve reader stack samples of varying thickness and composition, with free layer thickness as thin as 30 Å. The silicon substrate wafers were first measured on the new loop tracer at a set stress level, and then cut up to coupons that were measured on a cantilever system from Lafouda Solutions. Both instruments used an applied field of 100 Oe for each measurement. Fig. 1 shows the agreement between cantilever and loop tracer is excellent across a wide range of magnetostriction Lambda values, reaching from negative to positive. Details as well as limitations of this improved technique will be discussed.