Device Oscillation and Media AC-field Response of MAMR

Ian McFadyen, Zheng Gao, Terence Lam, Daniel Bai, Masato Shiimoto, Mrugesh Desai, Terry Olson, Prakash Mani, Paul Dorsey

Western Digital Corporation, San Jose, California

Hard Disk Drives have seen a $5x10^8$ increase in areal density over six decades. This has been made possible by numerous advances: the original inductive read-back process has been replaced with magneto-resistive (MR) readers, first AMR, then GMR, and currently TMR readers; single readers are being replaced with dual readers. The write field on the medium has continually increased due to reductions in writer-to-medium spacing (currently less than 1 nm), increases in write pole material magnetic moment, and a switch from longitudinal to keepered perpendicular recording geometries. These transitions have allowed the recording medium to change from the original particulate media to fine grain, thin-film metal media. Partial decoupling of the write process from the storage process using multilayer, exchange coupled media with lower coercivity, easy-to-write top layers coupled to higher coercivity, and more thermally stable lower layers has pushed magnetic recording to ~1Tbit/in^2.

However, the writer has always been an inductive magnetic write head, where a magnetic yoke and pole tip have been energized by an inductive write coil. In order to write even higher coercivity media, as we continue to decrease magnetic cluster size and increase areal density, more field is required than the inductive head can provide. Therefore Energy Assisted Magnetic Recording – HAMR (Heat Assisted Magnetic Recording) or MAMR (Microwave Assisted Magnetic Recording) [1] are now being developed and deployed. This Talk will focus on MAMR technology.

The MAMR head has a Spin Torque Oscillator (STO) within the write gap of the recording head as shown in Fig. 1. The STO provides an AC field to reduce the switching field of the medium. The microwave assistance effect enables use of higher anisotropy and higher coercivity media, and thus improves areal density. In this study, we fabricated MAMR heads and confirmed ~20 GHz oscillation peaks as shown in Fig. 2. We also confirmed MAMR unique recording characteristics with the fabricated MAMR head and media.

[1] J. -G. Zhu, X. Zhu, and Y. Tang, “Microwave assisted magnetic recording”, *IEEE Trans. Magn.*, 44(1) 125-131, (2008).

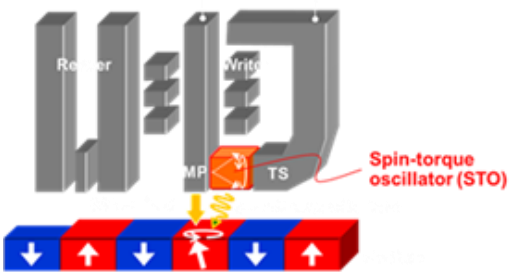

Fig. 1: Schematic diagram of MAMR head

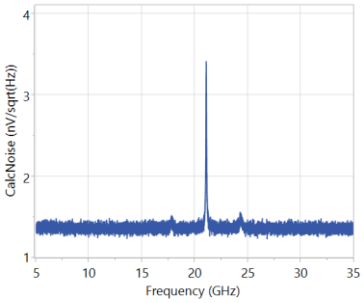

Fig. 2: MR measurement of STO oscillation