Optimization of the HF-MFM technique

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The high-frequency MFM (HF-MFM) technique is employed to visualize the high-frequency stray fields emanating of harddisk writer poles. HF-MFM is an extension of the standard MFM technique, using a commercial AFM system as a basis. In the literature, there were two different methods described, the amplitude modulation technique [1] and the direct phase detection method [2]. Recently, a so-called dual-vibrational technique [3] was introduced, which combines features of both older techniques. The key to the dual-vibrational technique is that the cantilever is driven not only by the piezo element, but additionally by the amplitude-modulated, high-frequency stray field of the harddisk writer pole. For optimum magnetic contrast in the HF-MFM images, the modulation frequency employed should then be related to the oszillation frequency of the cantilever. In this contribution, we investigate the effects of varying the modulation frequency on the magnetic contrast achieved. As probes, we employ SEAGATE harddisk writer poles. We find that the optimum condition for the HF-MFM operation is the use of a modulation frequency being about half of the cantilever resonance frequency. Together with optimized cantilevers, a clear improvement of the magnetic imaging is obtained. Furthermore, we can deduce that the optimum parameters for imaging must be determined for each experimental system (harddisk writer pole and cantilever) individually.

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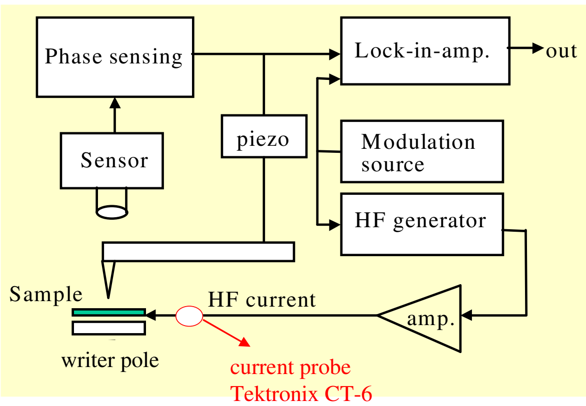

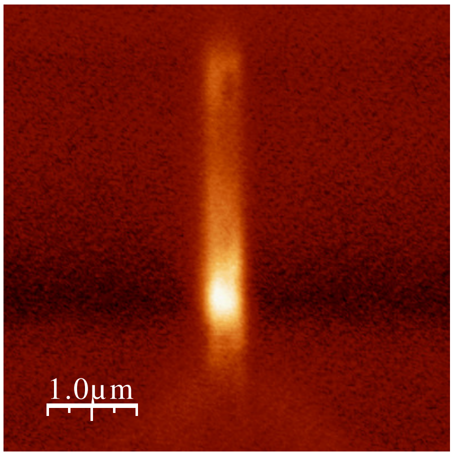

Left: Schematic setup of our HF-MFM system; right: HF-MFM image of a SEAGATE harddisk writer pole at a carrier frequency of 500 MHz.

References
[1] R. Proksch et al., Appl. Phys. Lett. 74, 1308 (1999).
[2] M. Abe and Y. Tanaka, IEEE Trans. Magn. 38, 45 (2002).
[3] S. Li et al., J. Appl. Phys. 91, 7346 (2002).