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Response of Magnetic Force Microscopy Probes under AC Magnetic Field

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In this paper, magnetic force microscopy (MFM) probes with different coating materials were characterized under AC magnetic field. A perpendicular magnetic write head similar to those used in hard disk drives was employed as the AC magnetic field generator. In order to measure a response of MFM probes to AC magnetic field, a MFM probe under test was scanned, at a scan height of 10 nm, across the surface of the magnetic write head. During MFM imaging, the write head was biased by a sufficient magnitude of AC current, approximately 30 mA. A spectral analysis for a frequency sweep from 1 kHz to 100 MHz was extracted from post-processing MFM images. As expected, a MFM probe coated with hard magnetic alloys, i.e. FePt, has the lowest response to AC magnetic fields. MFM probes coated with soft magnetic alloys, i.e. NiFe and NiCoCr, have a relatively high and flat response across the frequency range. In addition, CoCr, NiCo and pure Ni coated MFM probes show lower response than NiFe and NiCoCr probes at low frequencies; however, their response to AC magnetic field increase for the AC magnetic field with a frequency above 50 kHz. This can be implied that those MFM probes are a good candidate for being used to study the high-frequency performance of perpendicular magnetic write heads. Noting that response of all MFM probes significantly decreased when driven frequencies above 1 MHz due to the limitation of the hardware, i.e. response of quadrant photodiode and op-amp in a pre-amplifier.

Keywords: MFM tips, MFM, magnetic write heads, frequency response

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