

## A novel detection technique for electromagnetic interference induced playback signal distortion in CPP-GMR read heads

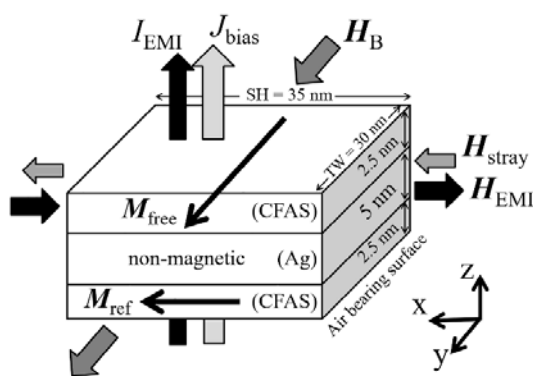
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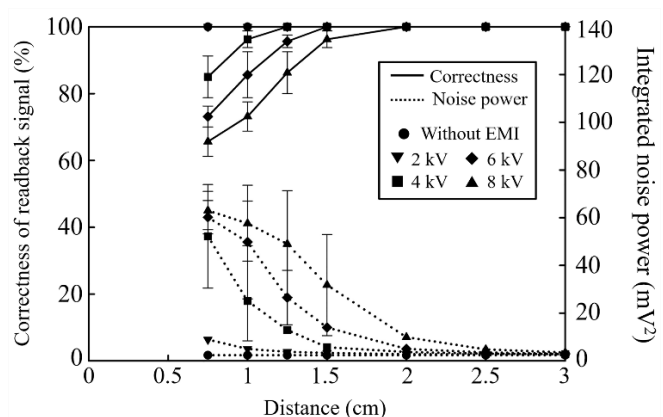
The current perpendicular-to-the-plane giant magnetoresistance (CPP-GMR) has been proposed extensively to be the next generation of magnetic read heads [1]. However, the electromagnetic interference (EMI) induced spin transfer torque (STT) noise is an influential factor causing stability degradation of CPP-GMR heads [2, 3]. Then, we proposed an investigation of EMI influence on playback characteristics of CPP-GMR head, including the readback signal, magnetic noise spectral density and bit-error-rate (BER), via micromagnetic simulations.

The CPP-GMR head including their surrounding factors is modelled, as shown in figure 1. The effects of EMI, radiated by the ESD following IEC 61000-4-2 standard, propagating through the head is considered as a source of STT induced magnetization fluctuation. The amplitude of magnetic and electric field ( $H$ -,  $E$ -field) of EMI measured with 2, 4, 6 and 8 kV ESD charging voltages at distances of 0.75 – 3 cm from the discharge point is indicated in our previous study [3]. Then, the characteristics of the readback signal, magnetic noise and BER of the head under the EMI effects are analyzed and are compared to that of a case without an EMI effect.

As shown in figure 2, it is found that EMI is unable to cause a noticeable effect on the head output response in case the EMI source is located at distances above 2 cm from the head, or ESD charge voltage is only 2 kV. However, the EMI can cause a significant decrease of the readback signal correctness and a rapid expansion of the noise, when the EMI is radiated at distances less than 2 cm or ESD charging voltages above 2 kV. The readback signal could become incorrect for almost 40% by the EMI, which markedly impacts an accuracy of reading process. The occurrence of STT effect induced magnetization fluctuation is found as a physical explanation for the readback signal distortion and the expansion of noise spectrum. Moreover, a rapid increase of BER due to the EMI is also indicated. Then, the EMI is the influential factor for high-density recording head.



**Figure 1.** Simulation model of the CPP-GMR read head under the EMI effects.



**Figure 2.** Correctness of readback signal and integrated noise power of the head under the EMI effects.

- [1] K. Nagasaka, J. Magn. Magn. Mater., 321, 508 (2009).
- [2] J. G. Zhu and X. Zhu, IEEE Trans. Magn., 40, 182 (2004).
- [3] P. Khunkitti, et al., J. Magn. Magn. Mater., 412, 42 (2016).