Technique for heat-assisted magnetic recording media promises improved writeability for next-generation hard drives

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Heat-assisted magnetic recording (HAMR) is a new process that realizes the three goals of magnetic recording—readability, writeability and stability. A*STAR researchers have now succeeded in improving its writeability by employing a thermal design that permits a higher density

recording1.

HAMR magnetically records data using a laser to locally heat the area being written. Careful control of the thermal spot size on the medium and the thermal gradient during writing allows more information to be written in a smaller area. The recording medium's thermal profile is influenced by its physical and chemical properties, such as its optical characteristics, microstructure and layer structure, which impact the recording performance and density.

Jiang Feng Hu and his team from the A*STAR Data Storage Institute wanted to better control the thermal profile. The three layers making up the write layer—the heat-sink layer, underlayer and top layer—must support high thermal gradients. In addition, the top layer should be crystalline with controllable microstructural features. An L10-ordered iron–platinum alloy film is a popular top layer as it exhibits a high magnetic anisotropy.

However, choosing a suitable heat-sink layer is challenging. Copper-based materials are attractive due to their high thermal conductivity, but a mismatch between the structures of the crystalline layer and the underlying magnesium oxide limits the growth of the L10 phase. Although this mismatch can be corrected by inserting a layer between the heat sink and the underlayer, doing so reduces the thermal performance of HAMR media—"This will produce a smaller thermal gradient and media signal-to-noise ratio (SNR)," explains Hu. This is problematic as a high SNR is a critical measure of recording-media performance.

Hu's team focused on a technical solution called the 'seed-then-heat-sink approach' and corresponding media design. As this design does not require an additional layer, it attains a large thermal gradient and a higher media SNR. A textured copper nitride film is used as a seed layer

to induce an orientation of magnesium oxide that promotes L10-ordered iron–platinum film growth. The subsequent deposition of the iron–platinum alloy film, as a high-temperature process, decomposes copper nitrate into copper, which provides a suitable heat-sink layer.

Hu notes this approach enables a large thermal gradient during the writing process. "This large thermal gradient is critical to the iron–platinum-based medium for HAMR application, especially for HAMR media with smaller grains to support the ultrahigh areal density that HAMR technology is targeting," says Hu.

More information: Hu, J. F., Jian, Z. S., Tie, J. Z., Cher, K. M., Bao, X. X, et al. HAMR medium structure design and its process for excellent thermal performance. *IEEE Transactions on Magnetics* 50, 3201106 (2014). dx.doi.org/10.1109/TMAG.2013.2286615

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