HAMR and Beyond: a journey from Research Concept to Data Storage Products

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Abstract

Data is growing faster than the world's ability to store it. In 2024, the people of Earth will generate 30 zettabytes of data each year—but only 2 zettabytes of storage capacity are manufactured each year. To address such demand for data storage, Heat Assisted Magnetic Recording (HAMR) has proven to be the primary successor to perpendicular magnetic recording – productization is well underway in 3 TB/disk configurations [1,2]. HAMR addresses the magnetic recording "trilemma" [3-5] more effectively than other energy assist schemes by incorporating high anisotropy FePt-based media in hard disk drive (HDD) platforms. FePt media can be scaled to small grain sizes, enabling areal density growth while maintaining thermal stability. HAMR heads feature a near field transducer that converts far field light incident from a laser to near field light at the media surface [3-5]. These apply high temperature to FePt media grains during the write process, thereby lowering the anisotropy of the grains enough to be written by the magnetic fields supplied by the HAMR head.

High areal density HAMR demonstrations have been published through the years [6],[7], including recent demonstrations presented at TMRC 2024, experimental spin-stand recording data in excess of 5.5 TB/disk a demonstration of 4 TB/disk in a fully formatted, factory-processed drive [8].

In the talk, we will present the research and development journey for HAMR technology, from the research concepts to the data storage products. Potential prospects will also be discussed on technologies extending the recording density growth and critical challenges before it could become a viable technology path.

References

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Figures

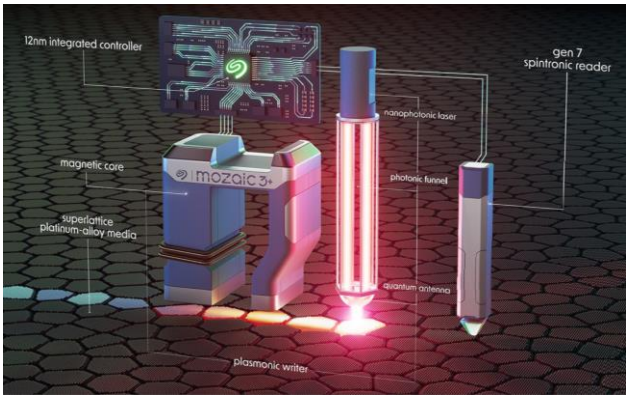

Figure 1. Critical Technology Innovations enabling Seagate's MOZIC3+ HAMR Product platform.

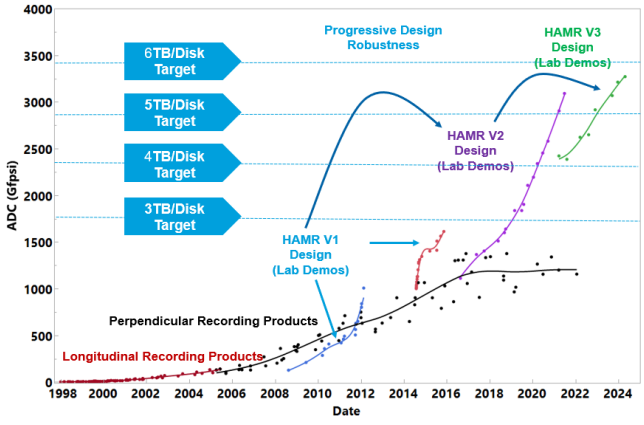

Figure 2. Areal Density Capability (ADC) over time for Seagate longitudinal recording products, perpendicular recording products, and HAMR laboratory demonstrations.