Barium Ferrite: The storage media of the future is here today

*With Metal Particle reaching its limits, new technology delivers higher linear density for greater capacity*
Introduction
The rapid growth of big data, regulatory requirements for data archiving, and the extended periods of time that organizations now preserve data prompt significant needs for improved storage media. And while linear magnetic tape remains one of the most resilient, reliable and affordable data storage technologies, the demand for huge capacity that resists degradation can exceed its capabilities.

Now, to meet requirements for storing vast amounts of data created by computer-based sensors or the wide range of formats provided by medical imaging, security camera feeds, financial records and a host of other sources, IBM provides new Barium Ferrite (BaFe) magnetic particle-based media. This advancement in tape technology provides a range of powerful advantages including micro-sizing of the magnetic particles to support ever smaller bit sizes, reduced thickness of magnetic layer to support high-density recording, enhanced smoothness of the magnetic layer to reduce spacing loss, and more.

This white paper will examine BaFe technology and standard Metal Particle (MP) technology to provide comparisons between the two and explain the benefits of BaFe media. It will also explain the reasons for the stability and reliability of BaFe technology that serve as the basis for its use in solutions such as IBM Linear Tape-Open (LTO)-6 and IBM® 3592 Advanced Type C tape cartridges.

Why Barium Ferrite?
Until recently, MP technology was the only process used to manufacture LTO tape. The technology has proved reliable, with more than 200 million MP LTO tapes now in use throughout the world. However, MP technology is reaching its limits for a reliable high-capacity tape. Advancing to BaFe particles provides a more stable future for data storage.

Over the past six generations, tape has achieved a significant 25-fold gain in capacity through an increase in tape length (45 percent), linear density (more than 400 percent) and track density (more than 500 percent). Achieving these gains in linear and track densities required improvements in heads, format, mechanical control and media. One aspect of media improvement has focused on particles. As shown in Figure 1, metal particles are an iron-cobalt alloy with a thin passivation layer around the surface to prevent the rest of the alloy from oxidizing.
The thickness of the passivation layer has decreased somewhat as MP technology has matured, but as the overall particle size has been reduced from 100 nm in LTO Ultrium 1 to about 35 nm in LTO Ultrium 6, the improvement in passivation layer thickness has not been enough to prevent the layer from becoming a larger percentage of the overall particle. MP technology was not able to achieve the signal-to-noise ratio needed for reliable data transfer at higher linear densities without very smooth media. The time had come, as a result, for a new particle to move tape forward to the reliable, low-cost storage solution it is today.

What is Barium Ferrite?
BaFe particles are smaller than the metal particles used in LTO tape, yet they have higher coercivity. BaFe particles are also intrinsically more stable. Shown schematically in Figure 2, they are already an oxide, and therefore do not need a passivation layer to maintain stability.

The smaller particle size leads to a higher packing density for BaFe media compared with MP media. Coupled with the higher coercivity and better signal-to-noise ratio, this allows for a higher linear density, leading to greater capacity. IBM has already used BaFe to great effect in its 3592 Advanced Type C tape cartridge for IBM System Storage® TS1140 Tape Drive, quadrupling the tape capacity to 4 TB. Future generations of LTO are expected to use BaFe particles to achieve the increased capacities demanded.
Why use BaFe media for LTO Ultrium 6 when MP media could work?

BaFe media has better magnetic properties compared to MP, resulting in a higher signal-to-noise ratio and a reduced bit-error rate. The result is a better product for the tape user. The smaller particle size means that there are more particles per unit volume, and that they can pack better, as demonstrated in Figure 3 and Figure 4. These superior properties mean that BaFe media has much better operating point margins than MP tapes. BaFe tape is also smoother, leading to less wear for both these components in use, giving the user greater reliability.

Because BaFe is an oxide rather than a metal alloy, it does not experience the inevitable demagnetization that occurs over time with MP tape. Written tapes are more stable long term, meaning that the user can have more confidence in the archive.

Why choose BaFe solutions from IBM?
IBM has more than 60 years of experience in tape and testing tape, and holds high standards to tape cartridges branded with the IBM logo. While the LTO logo indicates interchangeability, it is not a measure of quality. To be awarded the IBM logo, the tape media has to meet a high bar for quality and reliability, and is continuously tested and monitored.
IBM media undergoes environmental durability tests at all “five corners” of temperature and humidity extremes, putting media through its entire lifecycle of 22.2 million motion meters of tape in warm/wet, hot/wet, hot/dry, cold/dry and cold/wet environments. The extensive suite of IBM stress tests in real and extreme customer environments leverages both the long IBM history of tape experience and ongoing development of testing methods, enabling IBM to meet customer needs and solve real-world storage media problems.

In selecting a media for LTO Ultrium 6, IBM tested both MP and BaFe tapes. Based on this extensive testing, including on both new and end-of-life drives, IBM found that BaFe provides much greater margin over MP. IBM selected BaFe tape due to its better performance, better head-wear properties and better archival properties. After studying all of the data in a direct comparison, IBM engineers have determined that BaFe offers longer archive life, is a better solution for the reliable transmission and storage of data on tape, and results in less wear for drives.

The bottom line: the standard of the future is here today for LTO Ultrium 6 BaFe and IBM 3592 Advanced Type C tape cartridges.

For more information
To learn more about IBM LTO-6 BaFe and IBM 3592 Advanced Type C tape cartridges, please contact your IBM representative or IBM Business Partner, or visit: ibm.com/systems/storage/media

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