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High Performance Media for High Performance Drives

By Rich D'Ambrise

New SDLT 600 tape drive technology has imposed new capacity and performance demands on media manufacturing processes. As tape technology evolves, new higher-performing magnetic particles and tighter tolerances must be developed to keep pace with industry growth and end user data management needs.

To achieve the required capacity and performance targets, SDLT II media incorporates a broad range of enhancements. The result is a tape cartridge with vastly improved magnetic performance and enhanced durability to handle the demands of Quantum's SDLTape 600 drive technology.

SDLTape II media is a dual-coated media that employs a highly precise coating process to achieve a durability requirement of one million head passes. This formulation is based on a new ultra-fine ceramic armor metal particle that is 40% smaller than first-generation SDLTape

media and possesses a higher magnetic power of 2600 oersted with superior archival properties. The particles, uniform in shape and size, are less than 60 nanometers long. By contrast, the technology used in Super DLTape I media has a particle size of 100nm. Each metal particle is coated with a thin ceramic layer to protect it from corrosion and oxidation, and provide advanced archival storage durability.

To maximize the magnetic performance of the particles, new binder and base film components were developed by double-coating a base film layer, wet on wet, with a thick nonmagnetic protective layer and an extremely thin magnetic outer layer. The high-performance binder system combines two different binders mixed with cross-linked material, allowing for a strong connection of metal particle and increased durability.

The recording layer is a mixture of 80% magnetic particle and 20% binder materials. The recording layer coating includes head-cleaning agents and two classes of lubricants to

minimize friction between the tape and the read/write heads. The combination of two lubricants meet high-duty cycle demands of SDLT 600 drives by reducing tape and head wear, and repelling airborne debris that can clog the heads and affect read/write performance.

The advanced tape coating technology is supported by a new Super polyethylene terephthalate (S-PET) base film, a super-tensitized (pre-stretched) version of the PET base film used in SDLTape I media. S-PET's formulation reduces the overall thickness by 10% and contributes to capacity improvement by enabling an additional 200 feet of tape inside SDLTape II cartridges. The combination of higher-performance metal particles, an enhanced binding system, the ultra-smooth coating surface, and S-PET base film allows Super DLTape II media to accept shorter wavelength recording. This achieves higher data density and performance with better signal response and improved signal strength than Super DLTape I media or other technologies.

SDLT II media relies on an extremely thin, smooth backcoating layer to support one of the SDLT's optical servo positioning systems. The common method of creating servo-positioning tracks on the tape is to embed magnetic servo tracks between the data tracks on the recording sur-

face, reducing the physical space available to write data. SDLTape II's servo design leverages the Pivoting Optical Servo (POS) technology introduced with the first-generation SDLTape.

Instead of using conventional magnetic servo technology that is the norm with other tape technologies, the back-coat layer of Super DLTape II media is embedded with microscopic optical servo tracks which are read by a laser to provide highly accurate head positioning. This is a necessity with the extreme density of SDLT 600 drives. Because of this unique design, Super DLTape II media is not susceptible to high magnetic fields that can impact tape cartridges with magnetic servo positioning tracks. In fact, media that rely on servo tracks that have to be magnetically preformatted at the factory can be rendered inoperable, and critical data lost forever by such exposures.

The Future: Beyond SDLTape II

The enhancements represented by Super DLTape II media provide the technology base to enable the next generation of SDLT technology, expected to provide a native capacity of 800GB and 1.6TB compressed capacity per cartridge. Figure 2 shows the next two stops on the SDLT roadmap, from SDLTII through to SuperDLTS-5. Reaching these capacities with yesterday's

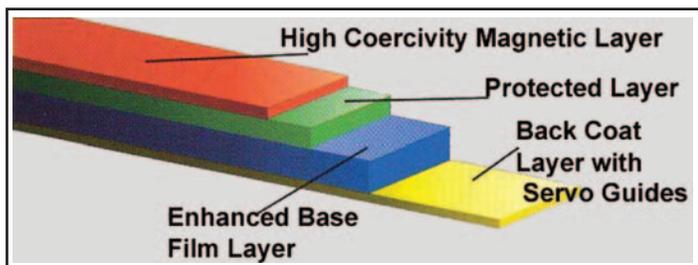


Figure 1: Media composite

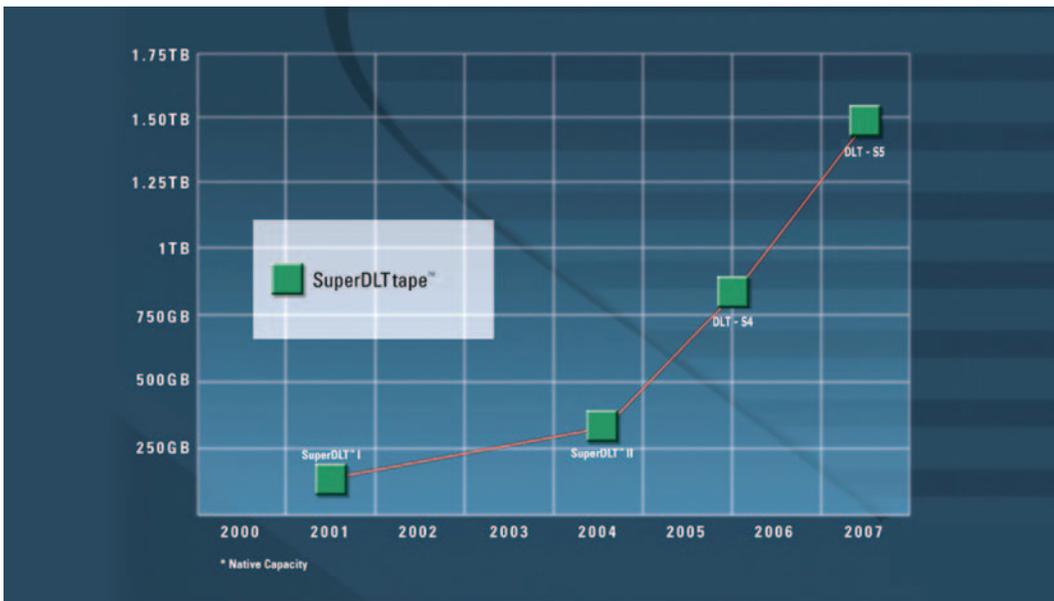


Figure 2: SDLT roadmap

magnetic particle technology could prove problematic around the one-terabyte mark, as there are physical limitations to the particles themselves that will inhibit further capacity improvements.

To reach native terabyte-class tape cartridge capacities and beyond, Maxell has developed Neo Super Maximum-capacity Advanced Reliability Tape (NeoSMART)—a collection of advanced technologies and production methodologies designed to support native capacities of up to 10TB per cartridge and beyond. NeoSMART technology is built around a new magnetic particle—NanoComposite Advanced Particles (NanoCAP)—which solves some of the fundamental problems that limit the capacity

potential of current acicular (needle-shaped) magnetic particles.

To date, the push for higher capacities has focused on the development of smaller acicular particles that can be packed more densely on the tape—the approach used with the particles for SDLTape II media. However, as the needle-like magnetic particles become smaller, both coercivity (ability to retain magnetic energy) and saturation magnetization (amount of magnetic energy) that are essential for increasing recording capacity and density tend to decrease. This trade-off between coercivity/magnetization and particle size has been the primary impediment to major capacity increases. It is theoretically difficult to continue to engineer needle-like par-

ticles for advanced magnetic tapes that require higher recording densities.

NanoCAP technology resolves these issues with a magnetic particle that enables improvements in magnetic energy not simply by downsizing the needle-like magnetic particles, but by the evolution of the individual particle itself. NanoCAP particles are produced through advanced miniaturization to create ultra-fine spherical-shaped particles with excellent coercivity and saturation magnetization for advanced magnetic recording performance.

NanoCAP particles have a diameter of about 20nm, about one-third the size of SDLT II particles and one-fifth the size of needle-like metal magnetic particles such as those

employed in earlier generations of DLT, SDLT and LTO. This delivers extraordinary magnetic performance, coercivity exceeding 3000 oersted, and extremely high saturation magnetization of over 120emu/g. NanoCAP offers a 200% improvement over Barium-Ferrite magnetic particles, well known for high coercivity and long considered one of the more promising candidates for future high-density magnetic recording media.

The innovative spherical shape of NanoCAP particles allows the closest possible packing structure, enabling higher recording densities and allowing the use of a thinner magnetic layer coating that can boost output levels. NanoCAP particles are also well suited for vertical magnetic recording in future recording methods.

SDLT II drives and media, and the development of the NanoCAP and NeoSMART technology platforms are just the latest examples that demonstrate that tape is still an evolving and vital storage technology. As data requirements scale into hundreds of terabytes or petabytes, and vast amounts of corporate data must be maintained and archived, the role of tape may change, but the need for tape will not. **CTB**

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