

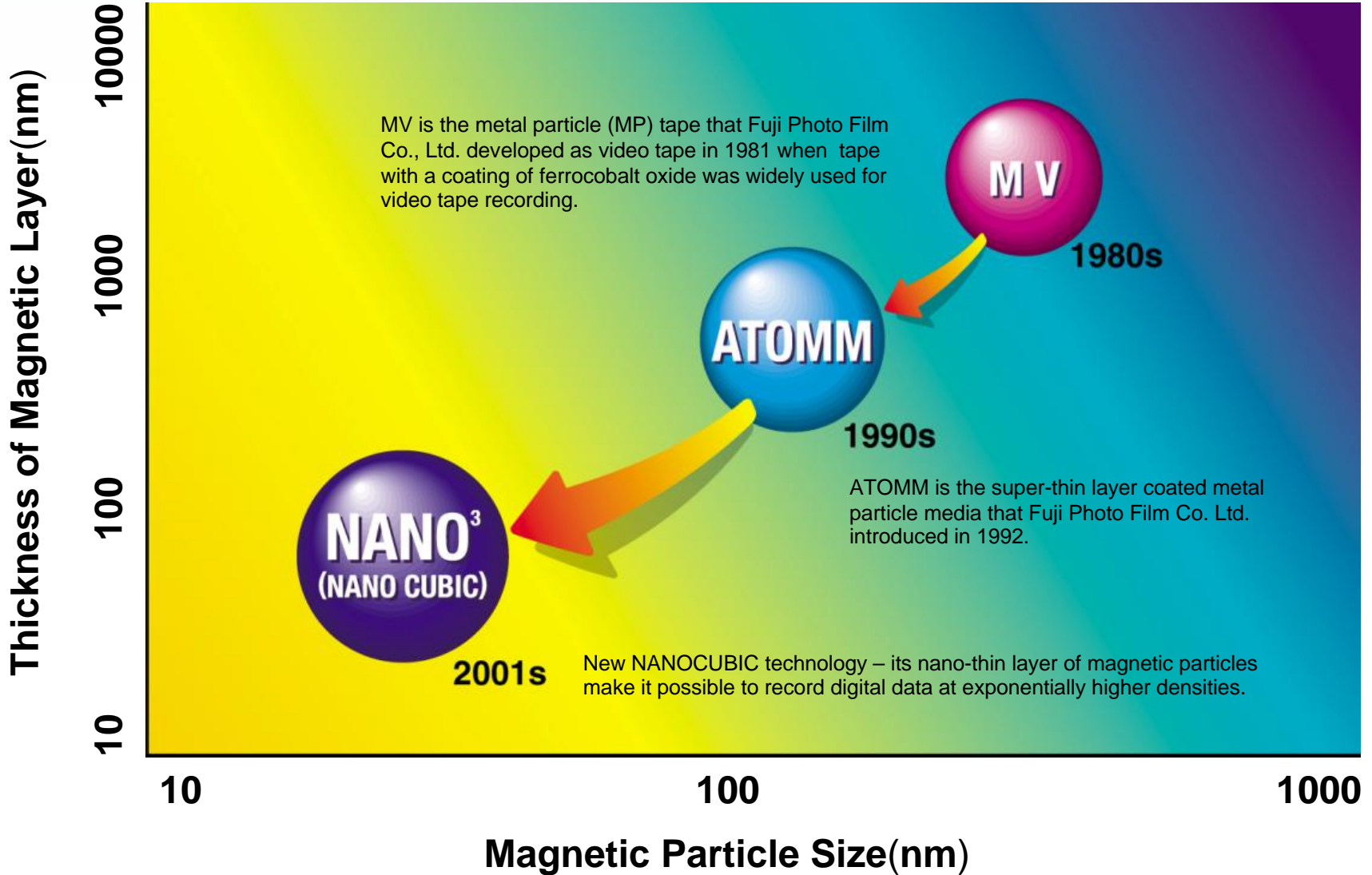
NANO³ Technology Seminar – May 2006

Fujifilm NANOCUBIC™ Coating Technology - Potential For 8 TB Data Storage Tapes.

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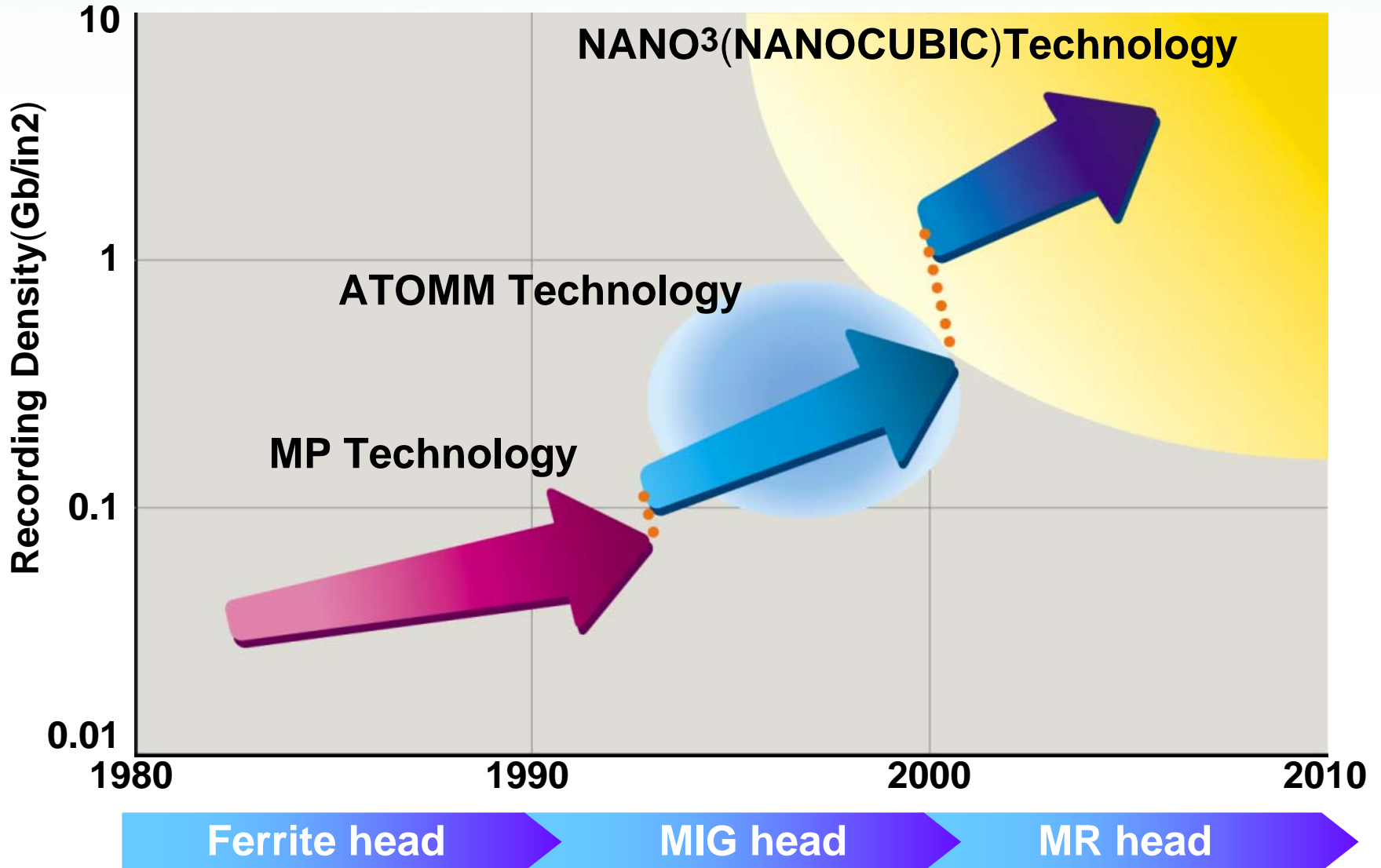
Technology change to NANO³ (NANOCUBIC™) technology



Fujifilm NANO³ (NANOCUBIC™) Technology

- ❑ NANOCUBIC technology is an ultra-thin layer coating that results in higher resolution for recording digital data, ultra-low noise and high signal-to-noise ratios that are ideal for magneto-resistive (MR) heads.
- ❑ NANOCUBIC Coating Technology precision coating at recording layer thicknesses below 100 nanometers enables recording densities more than 10 times higher than standard magnetic layers – potential for 8TB data storage and digital video tapes, plus 20GB flexible magnetic disks.
- ❑ Fujifilm will continue to develop ATOMM technology products for use in inductive-head *and* MR-head systems. NANOCUBIC technology products will be developed for MR, GMR and TMR head systems.
- ❑ NANOCUBIC coating technology can be applied cost-effectively to mass production manufacturing processes, requiring only small modifications to current ATOMM Technology coating equipment.

Evolution of Recording Density with Magnetic Layer Coated Recording Medium



Three Technologies of NANO³ (NANOCUBIC) Technology

❑ NANO Coating Technology:

- NANOCUBIC technology employs an advanced precision coating process that can control the thickness of the magnetic layer on a nanometer scale.

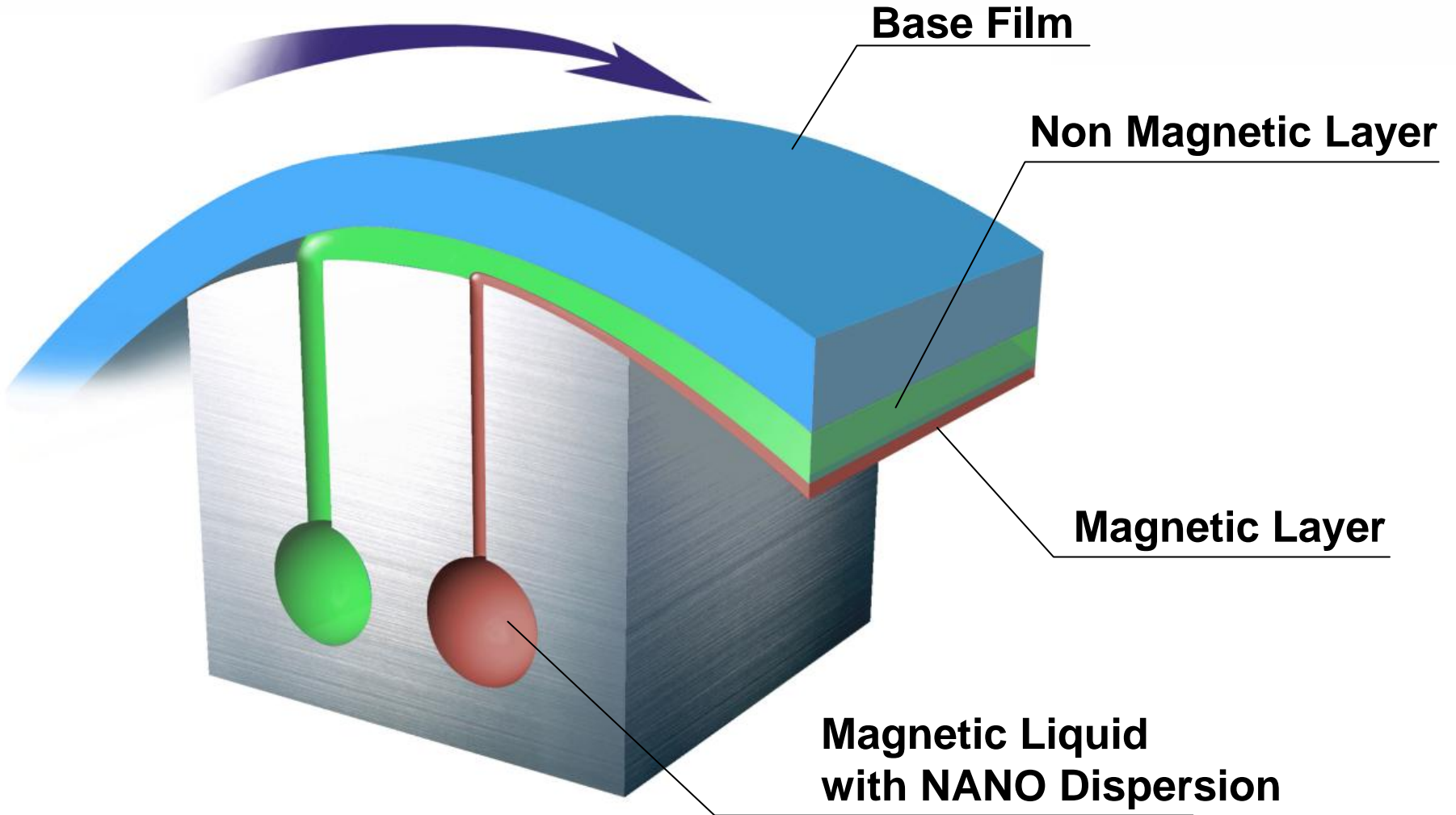
❑ NANO Particle Technology:

- Two types of magnetic particles were developed for NANOCUBIC technology, both tens of nanometers in size. The products will use one particle or the other particle, depending on the the application:
 - **acicular ferromagnetic alloy particle**
 - **tabular ferromagnetic hexagonal barium ferrite particle**

❑ NANO Dispersion Technology:

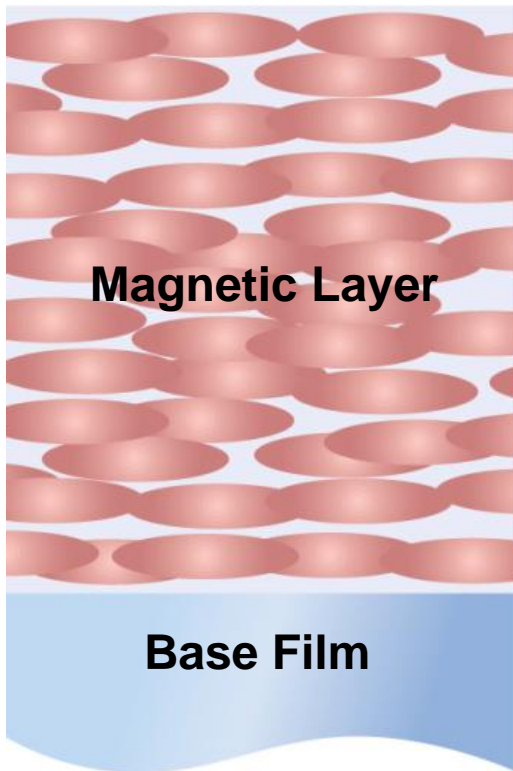
- NANOCUBIC technology uses a special organic binder material that has the ability to thoroughly disperse particles in the coating solution so that a uniformly packed structure of the layer is realized.

NANO Coating

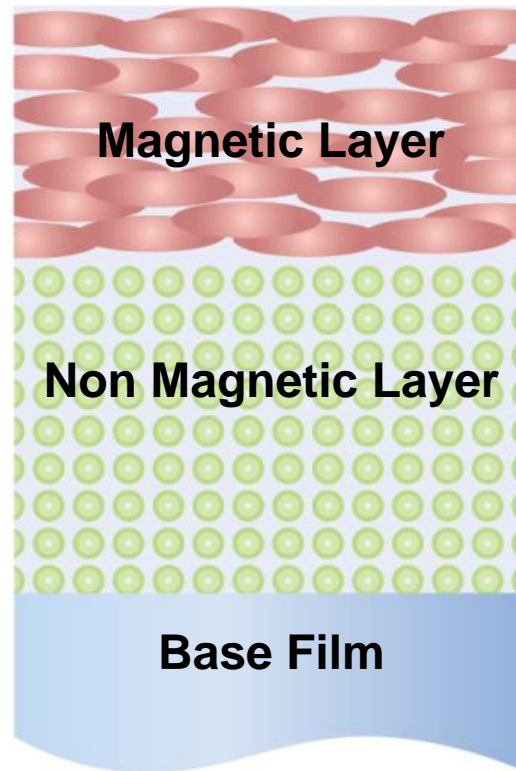


Construction of NANO³ (NANOCUBIC™) Technology

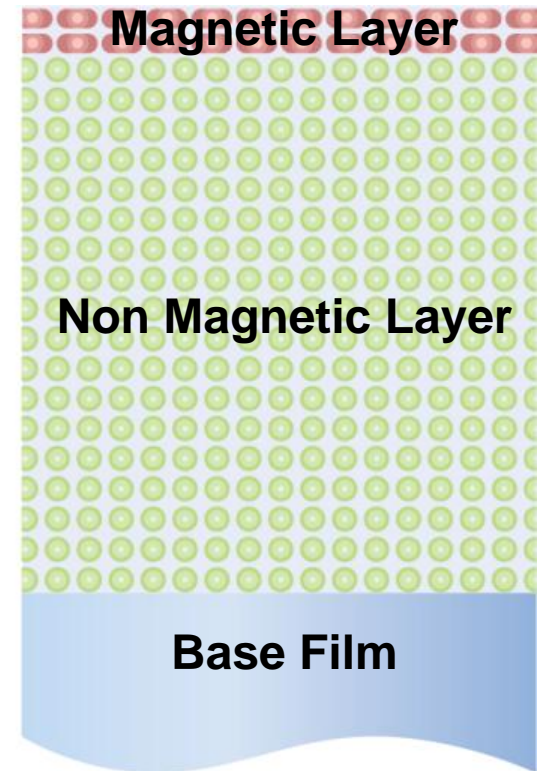
MP(Single Layer MP)



ATOMM Technology



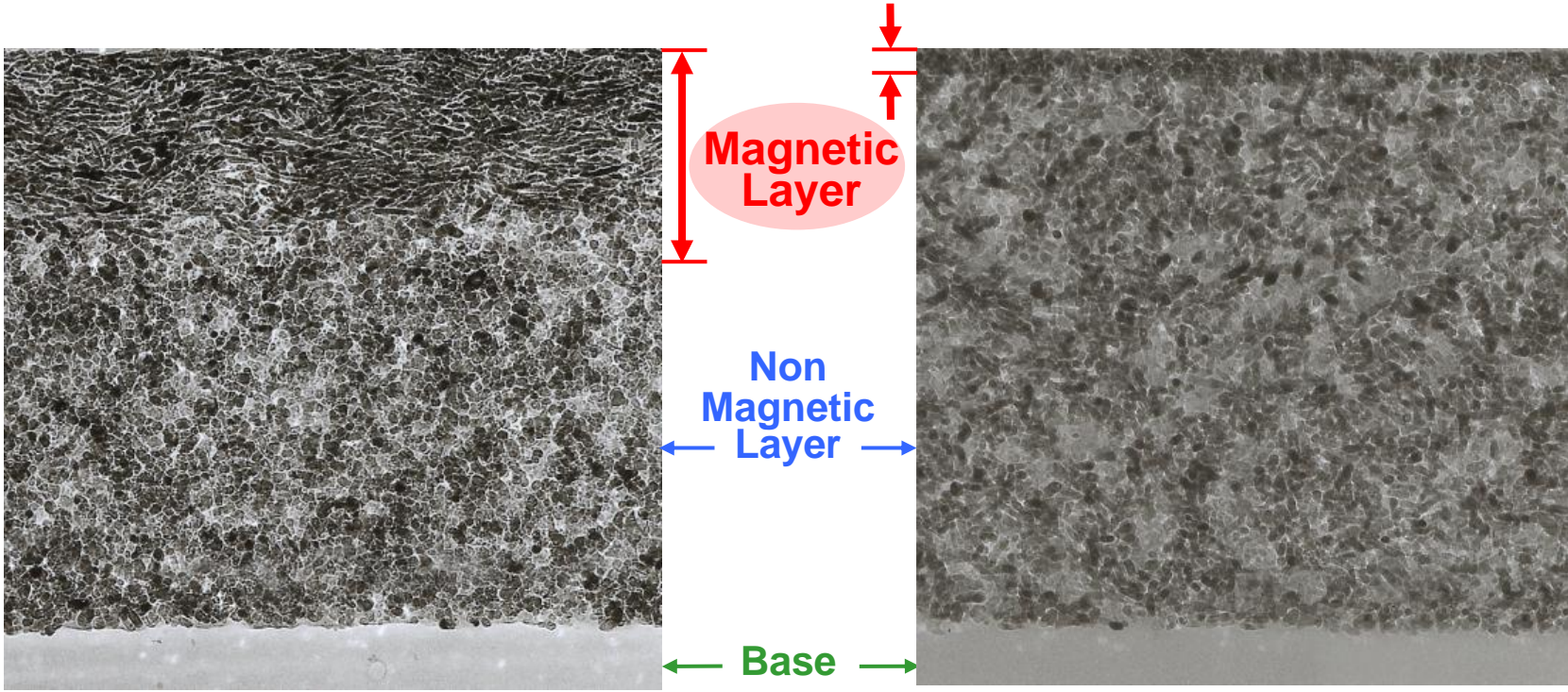
NANO³ (NANOCUBIC) Technology



Photograph of Cross-Section of Tape

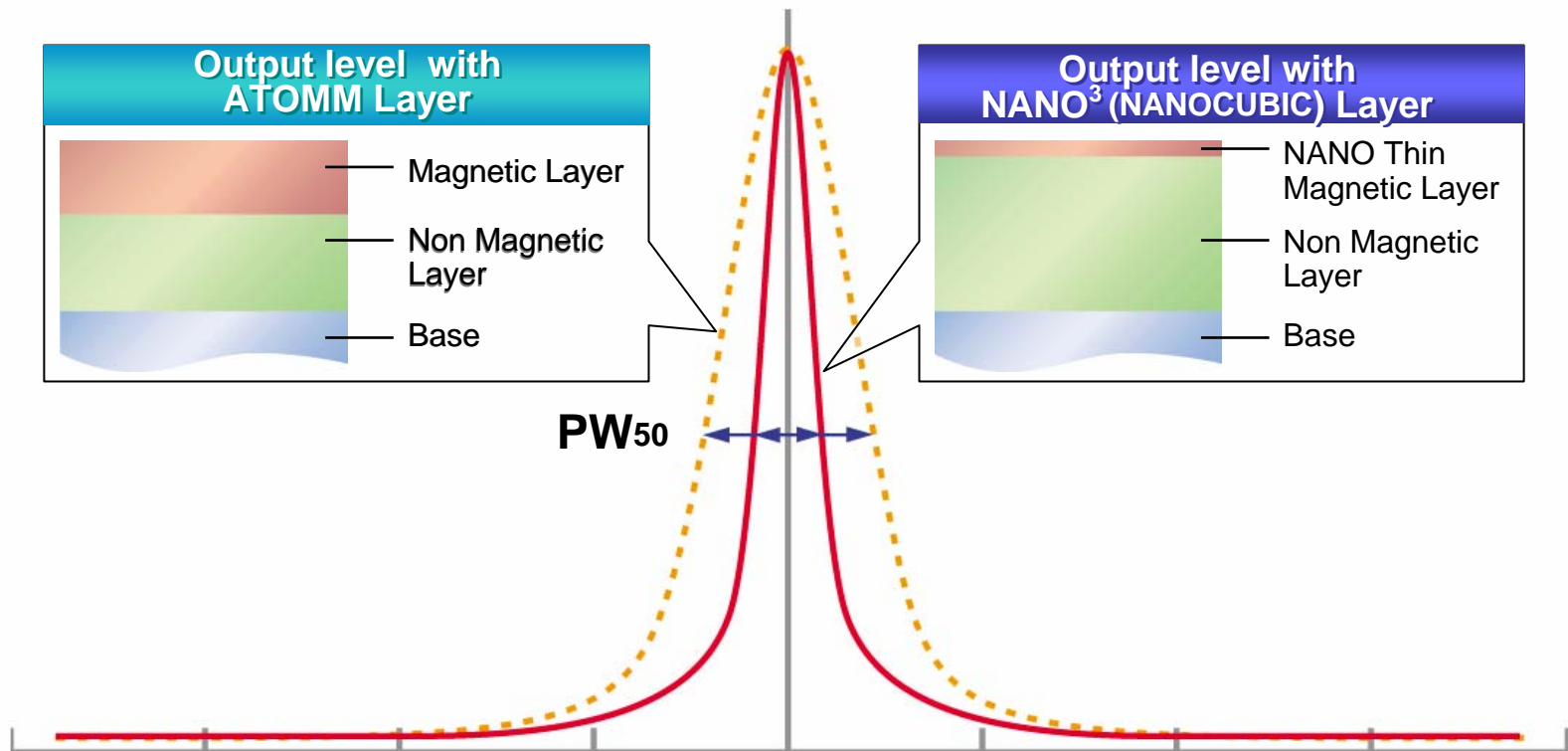
ATOMM Technology

NANO3 (NANOCUBIC) Technology



High Resolution

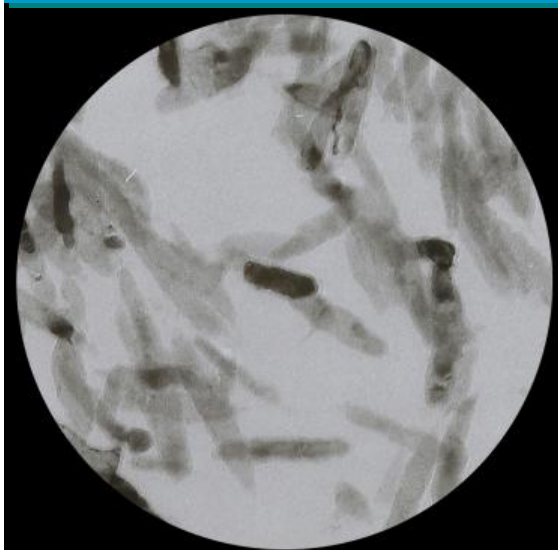
- ➔ In order to achieve high density recording, the isolated pulse shape must be very sharp, produce little jitter and have a narrow width at its 50% threshold (PW_{50}).
- ➔ PW_{50} is reduced by using a very thin magnetic layer.



Photograph of Magnetic Particle

ATOMM Technology

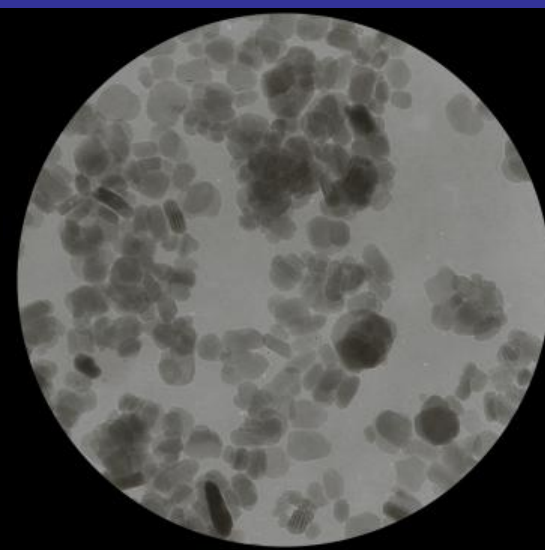
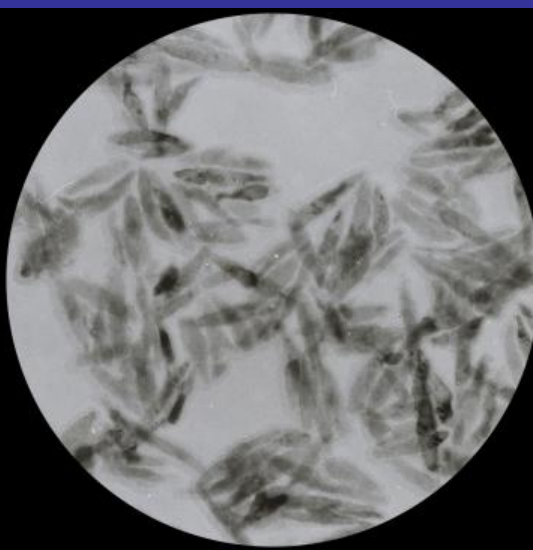
MP



NANO³ (NANOCUBIC) Technology

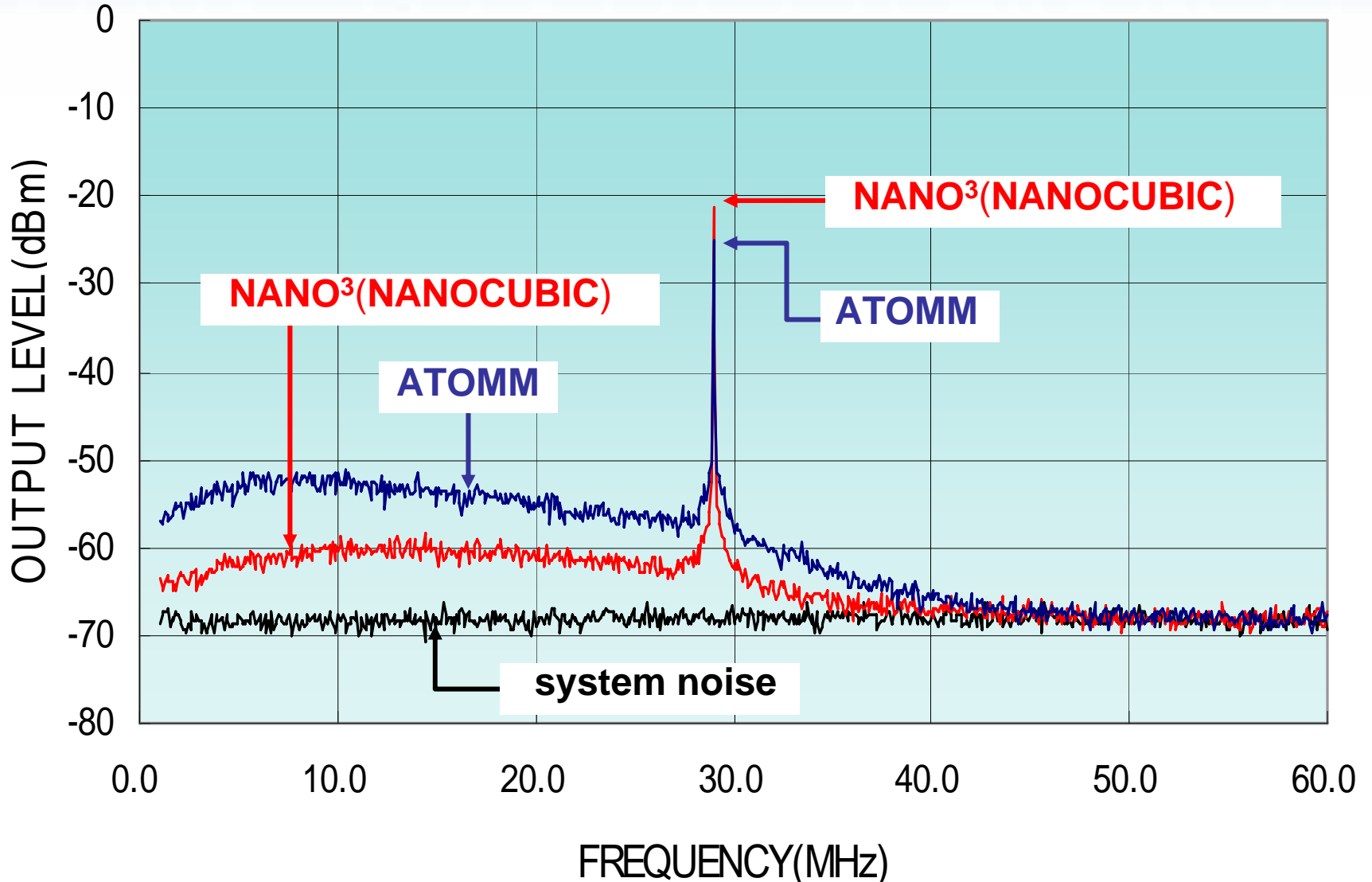
MP

Barium ferrite



Modulation Spectrum

Relative speed : 8.2m/s
Recording Signal : 180kfc



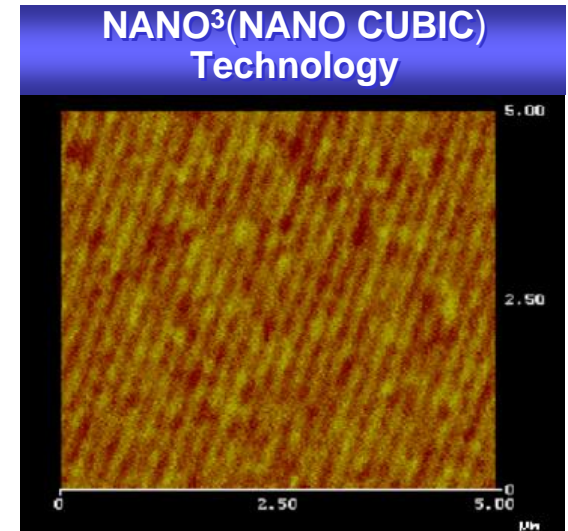
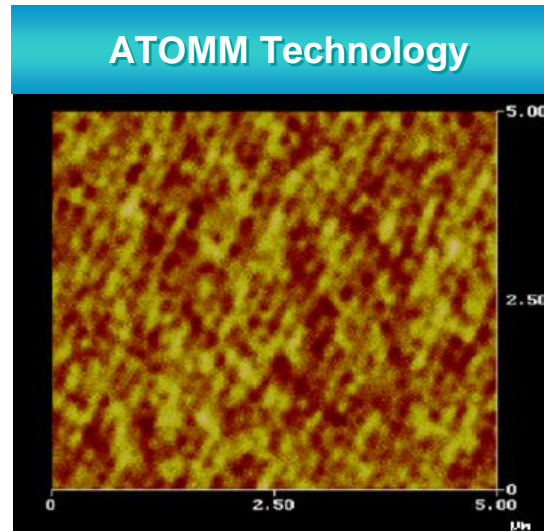
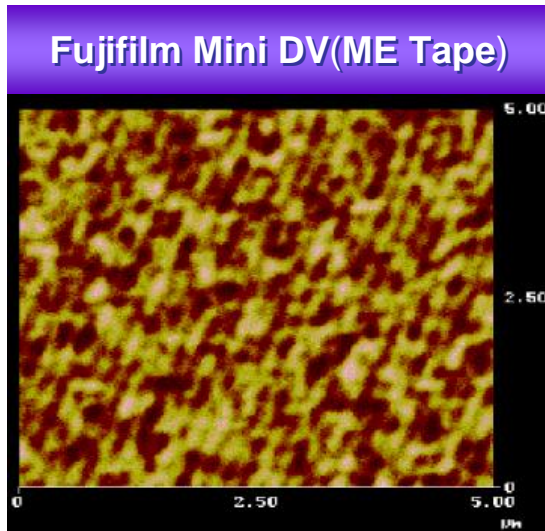
MFM Image of Recorded Signals on Magnetic Layer

NANO³ (NANOCUBIC) Technology

Thin Magnetic Layer
Fine Grain Magnetic Particle

Sharp Magnetization
Transition

High Resolution



This photograph is an observation of the recorded tape tracks magnified by MFM. (Magnetic Force Microscope) MFM observes the intensity of the magnetic field which occurs from the recorded tape directly. Sharper pattern image of MFM means higher resolution media.

Fujifilm NANO³ (NANOCUBIC™) Technology

- ❑ Fujifilm announced nanocubic™ Technology on November 6, 2001 and had begun to work with drive manufacturers to develop new, high capacity magnetic storage products using nanocubic technology.
- ❑ On May 13, 2002, IBM announced that it has recorded 1 terabyte of data to a linear tape cartridge, using Fujifilm's nanocubic media as a key component of their 1TB linear tape technology development.
- ❑ On July 22, 2003, Iomega announced the Digital Capture Technology platform based on a 1.8 inch flexible disk having a capacity of 1.5 GB using Fujifilm nanocubic magnetic media coating technology.
- ❑ On September 9, 2003, IBM began shipping the Enterprise 3592 Tape Drive and Data Cartridge based on 2000' x half-inch nanocubic media, which has a native capacity of 300 GB.
- ❑ On October 26, 2005, IBM introduced a new model 3592 Drive that can store 500 GB native on the same "300 GB" nanocubic cartridges, which have been shipping since September 2003.

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Fujifilm NANO³(NANOCUBIC™) Technology

- ❑ On November 4, 2005 Fujifilm announced production of new Sun StorageTek T10000 media incorporating NANOCUBIC technology. A single cartridge designed for the Sun StorageTek T10000 Tape Storage system provides 500 GB capacity (uncompressed).
- ❑ On May 16, 2006, IBM announced they had demonstrated a world record in data density on linear magnetic tape. IBM packed data onto a test tape at a density of 6.67 billion bits per square inch, more than 15 times the data density of today's magnetic tape.

IBM announced that this world-record achievement leverages new high-density dual-coated particulate magnetic tape media developed by Fuji Photo Film Co., Ltd., in Japan in collaboration with IBM Almaden researchers. This next-generation version of Fujifilm's NANOCUBIC™ tape uses the barium-ferrite particle.

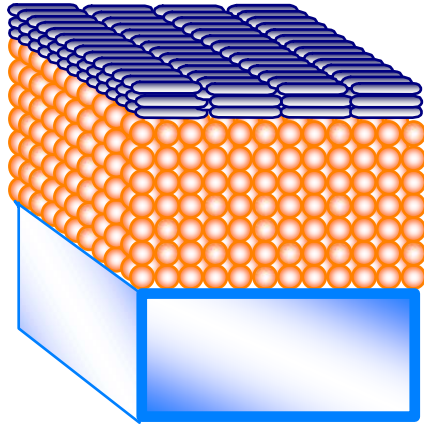
When products become available, projected in about five years, the drive and media technology will allow cartridges the size of an industry-standard Linear Tape Open (LTO) tape cartridge to hold up to 8 trillion bytes (8 terabytes) of uncompressed data.

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Think Fujifilm Media, for Today's & Tomorrow's Most Popular Drives!

Thank You!

 **FUJIFILM**



Advanced super
Thin-layer and high-
Output
**Metal
Media**

 **FUJIFILM**



nanocubic

Fujifilm's Coating Technology Creates Breakthrough Products

Fujifilm began coating motion picture and photographic film in the mid 1930's using die coating technology. Simultaneous multi-coating technology was developed in 1960. Also in 1960, Fujifilm produced its first magnetic tape products. In 1965, Fujifilm began manufacturing computer tape. Fujifilm's floppy disks (8-inch) were introduced in 1977. Fujifilm began manufacturing dual-coated magnetic media in 1989 and Advanced super Thin-layer and high-Output Metal Media (ATOMM) dual-coated media in 1992. For ATOMM, Fujifilm's special die coating head simultaneously applies two separate and unique layers, one magnetic and one non-magnetic. It's a dual coating system Fujifilm invented that has allowed us to continually develop the industry's "next generation" storage products and develop nanocubic™ Technology for data storage products with even greater capacities.

