Nano-Injection Molding Technology
for Ultra-High-Density Patterned Magnetic Media

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Demand for Ultra-High-Density Magnetic Media

- R & D
- MPR
- Patterned Media
- PMR
- Production
- 3D Recording
- Quantum Coupling

Areal density (Gbit/in²)

- LAC-HOR
- LAC: Laminated Antiferro-magnetically Coupled media
- HOR: Highly Oriented Recording
- PMR: Perpendicular Magnetic Recording
- MPR: Millipede Probe Recording

Year

- 1995
- 2000
- 2005
- 2010
- 2015
- 2020
- 2025

Ref. DSI
Motivation for Patterned Media

Conventional Continuous Media

- Barriers to Overcome
  - Medium Noise
  - Demag. Field
  - No Sharp Transition

Patterned Media

Zigzag Jitter @ Transition
Various Technologies for Patterned Media

- **Direct Patterning**
  - A. E-beam Lithography
  - B. Defining Magnetic Islands by
    - 1. Focused Ion Beam (FIB)
    - 2. Reactive Ion Etching (RIE)
    - 3. Ion-Beam Milling

- **Nano-Imprinting Technology**

Those technologies are fine **BUT**

**Not appropriate for mass-production**

due to low throughput, low yield and high cost!
Processes for Nano-Injection Molding Technology

(a) E-beam patterning

(b) ICP etching

(c) Si nano-master

(d) Fabrication of polymeric nano-master by UV molding

(e) Fabrication of metallic nano-stamper by electroforming

(f) Nano-injection molding

(g) Polymeric pillar patterns

(h) Deposition of magnetic materials
Fabrication of Polymeric Nano-Master

- Si Master
  (CD: 40nm, pitch: 80 nm)

- Polymeric Nano-Master by UV Molding
Fabrication of Metallic Nano-Stamper

Electroforming System

Metallic Nano-Stamper
Nano-Injection Molding Technology

Pattern Transfer

Ni Nano-Stamper

Polymeric Patterns
(\text{CD: 40 \, nm, pitch 80 \, nm})
Deposition of Magnetic Materials

Magnetic Islands on 3.5 inch Media (CD: 40 nm, pitch 80 nm)

Polymeric Patterns

Perpendicular Magnetic Media

3.5 in.
Previous Studies and Acknowledgment

(1) CD: 200 nm, pitch 500 nm

(2) CD: 100 nm, pitch 250 nm

*Single magnetic domain state*

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