Texture In Magnetic Recording Media

Contents

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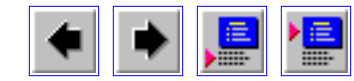
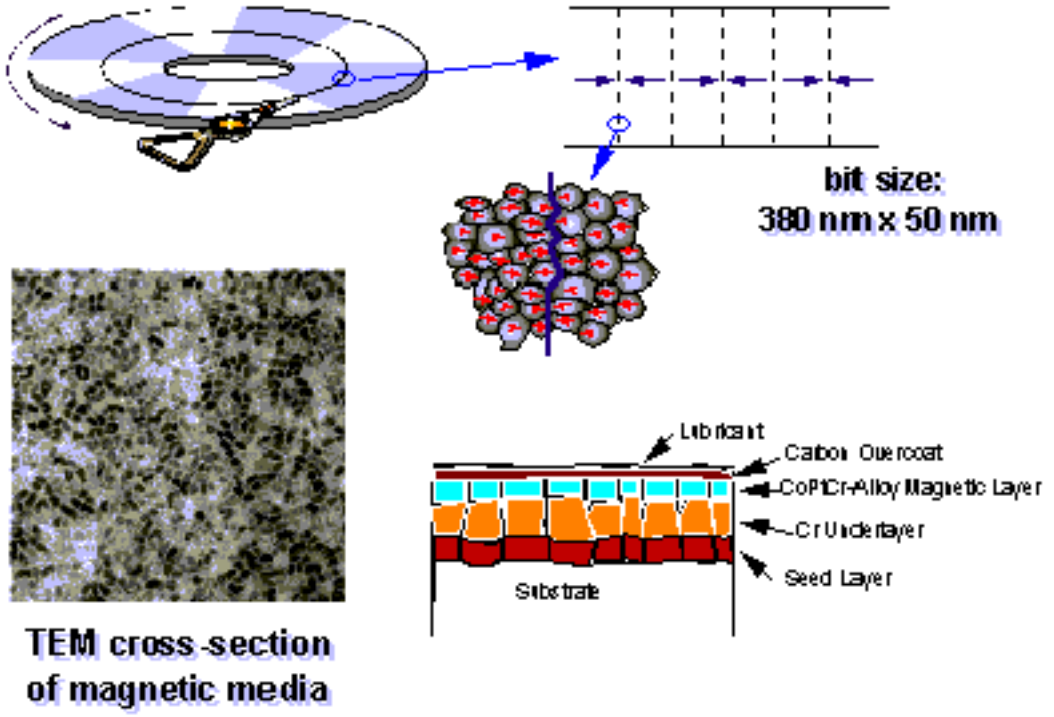


Magnetic Recording Disk



- note small grains => superparamagnetism
- get grain-to-grain epitaxy

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Outline

1. Overview of Magnetic Recording Technology
2. Recording Media
   - ➢ requirements & structures
3. Texture Measurement
4. Examples of Texture Effects
   - ➢ metal disks
   - ➢ glass disks with NiAl seedlayer
   - ➢ recent developments with glass disks
5. Perpendicular Media
6. Summary

Acknowledgments

Mary Doerner (IBM Storage Technology Division)
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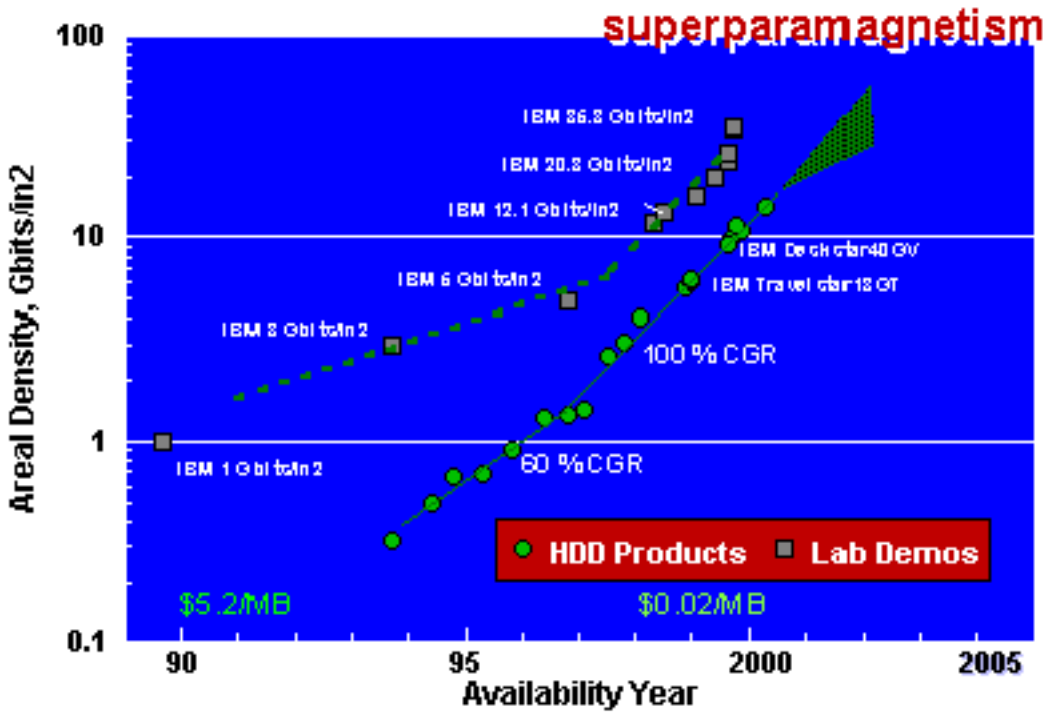
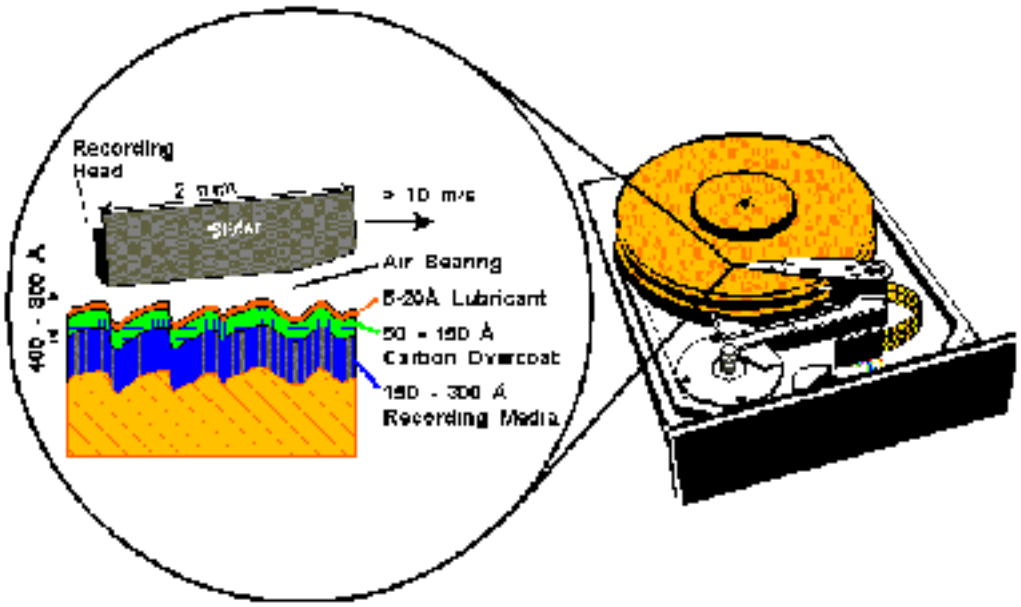
Areal Density Progress



- Areal density is growing at unprecedented 100% CAGR currently, i.e doubling each year
- We expect progress to continue at roughly this pace to 100 Gb/in2 using current technologies and using new ones beyond 100 Gb/in2.

Head & Disk Structures



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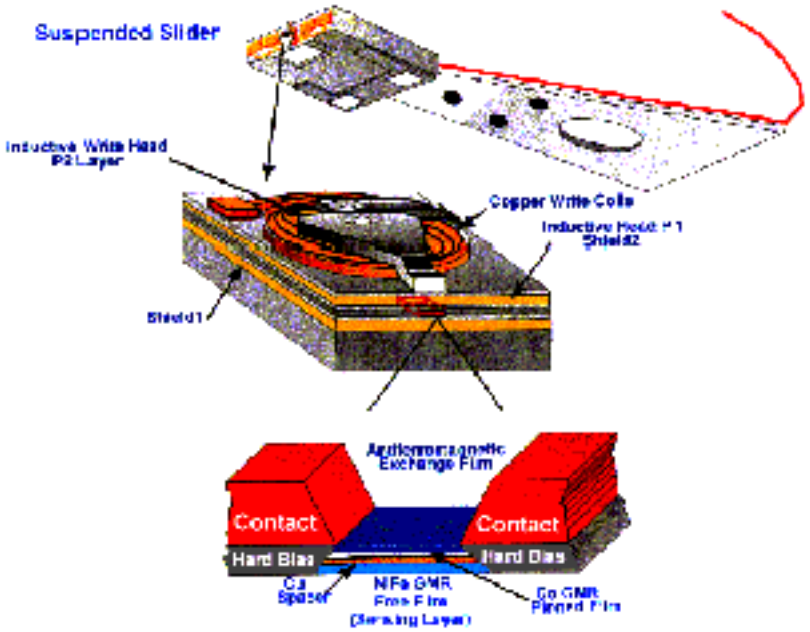
Recording Head



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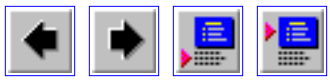
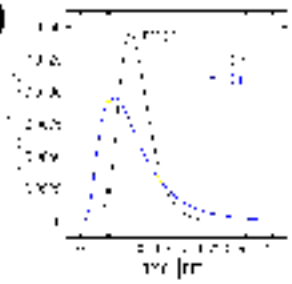
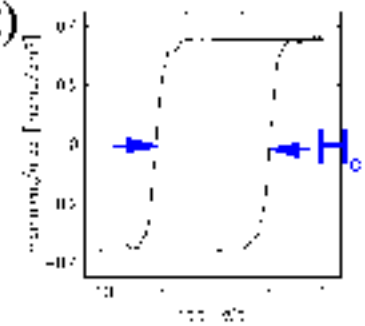


Recording Media Requirements

- high signal-to-noise ratio (SNR)
- small, isolated grains
- narrow grain size distribution



- thermally stable
- high coercivity (hard magnet)

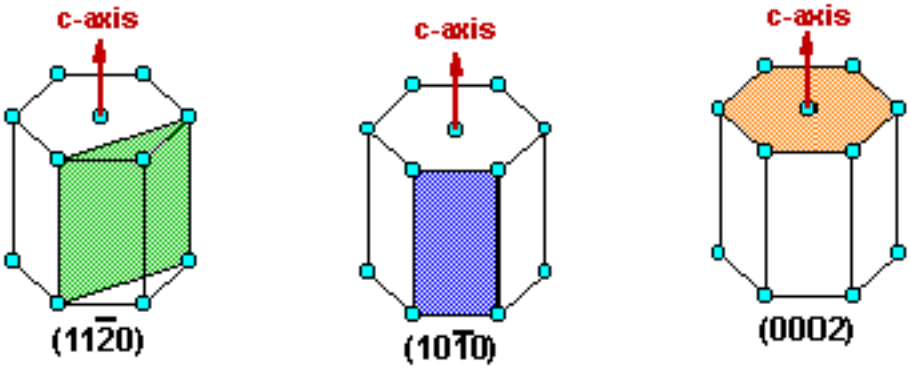


- smooth surface
  glass σ=4Å rms
  carbon σ=10Å rms

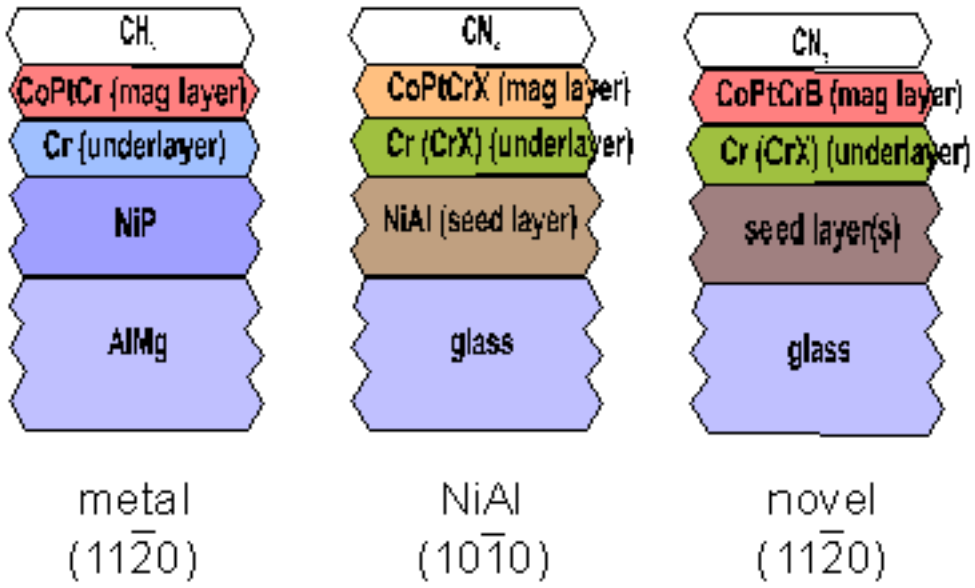
- stable => high Hc and squae loop

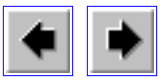
Media Crystallography & Texture

- Co-alloy media, hcp (some stacking faults)
- sputter deposition at ~200°C
- Co(70-80)Cr(10-20)Pt(5-15)[B(0-5) or Ta(0-5)]
- a≃2.55Å & c≃4.15Å
- longitudinal => c-axis in-plane



Disk Structures





Texture Measurement

- $\theta/2\theta$ scan
- rocking curve (ω scan) plot
- grazing incidence geometry
  - reduce substrate (& underlayer) scattering
  - limited angular range (polar angle 20-88°)

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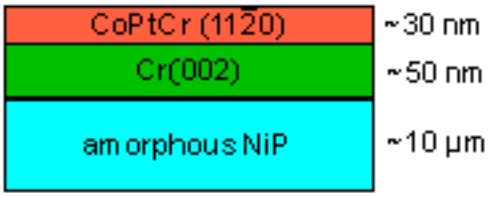
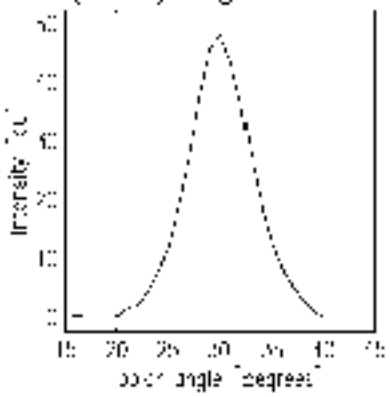
Metal Substrates



film deposition
- growth at high T (~200°C)
- substrate biased

produces well-oriented media
- 7deg fwhm

(10$\bar{1}$0) angle scan



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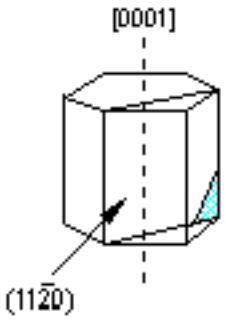
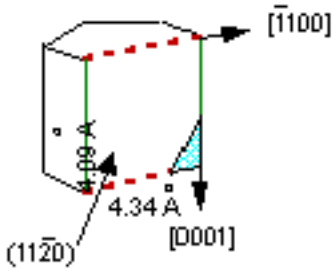
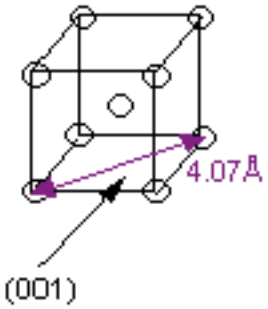
Media Texture Development

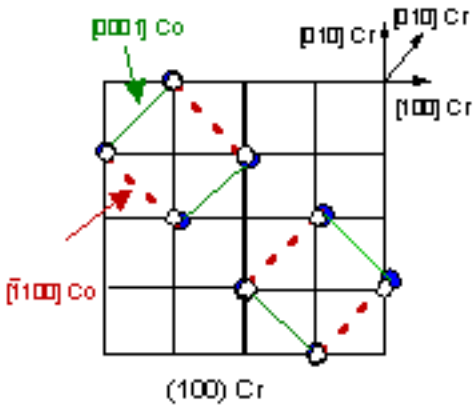
CoPtCr
mag layer:





Cr layer:
a=2.88Å





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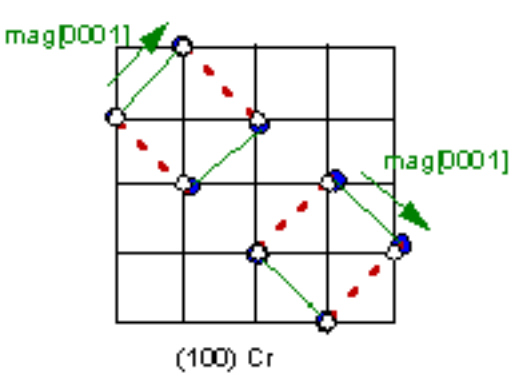
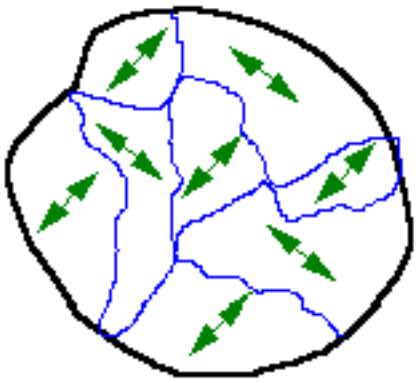
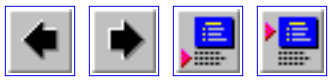
Bicrystals in (11$\bar{2}$0) Media

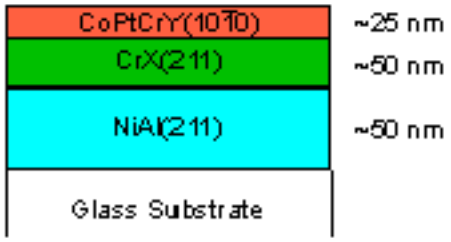




- lowers coercivity (H_c)



Glass with NiAl

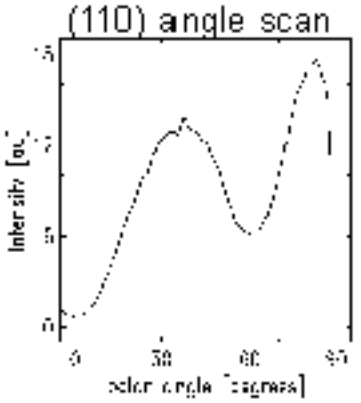


film deposition:

- growth at high T (~200°C)
- no biasing!
- Laughlin et al. MRS Proc. 475, 107 (1997)

role of NiAl:

- B_2 (CsCl) structure
- high T_m => grain refiner
- provides (211) texture, but poorly
- (211) texture better near top of NiAl



- glass used since smoother & more shock resistence
- CrX imporves lattice matching and others

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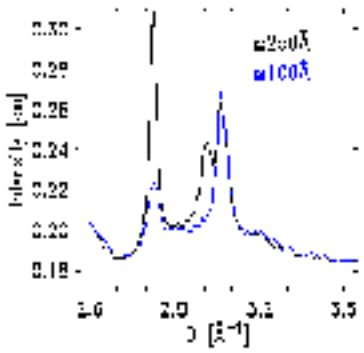
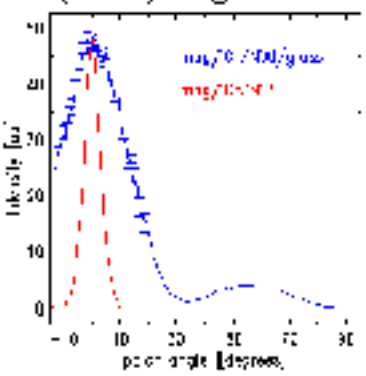
Glass with NiAl

specular

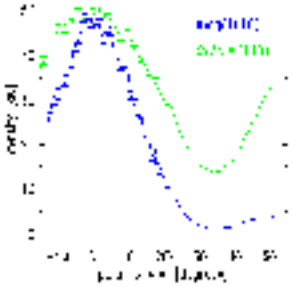


(10$\bar{1}$0) angle scan



- no bicrystals
- but poor texture
- poor texture inherited from NiAl/Cr

mag/Cr/NiAl/glass



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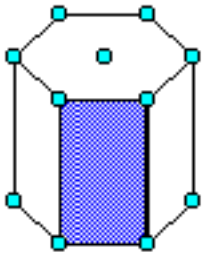
Media & Underlayer Texture



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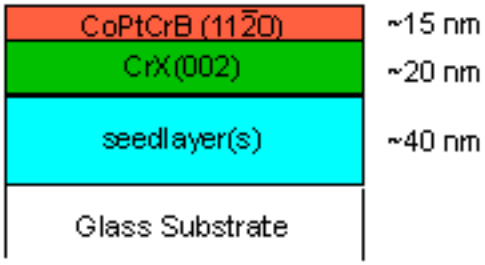
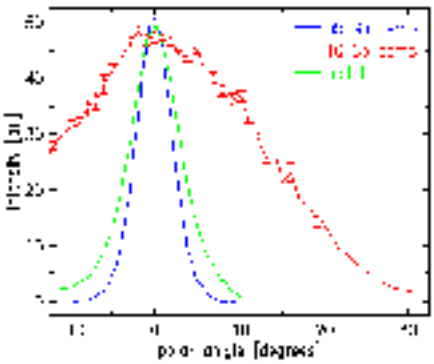
Glass with other seedlayers

IBM 35Gbit/in² demo (April, 2000)
MF Doemer et al., Intermag 2000; IEEE Trans Magn, in press.



Media microstructure:

- low level of fcc-like defects (stacking faults)
- small grain size with 'narrow' distribution (8nm ave and σ=0.56)
- no bicrystals
- excellent (11$\bar{2}$0) texture



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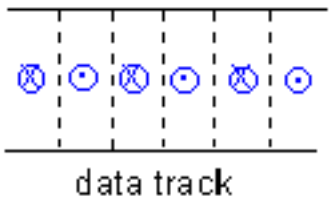
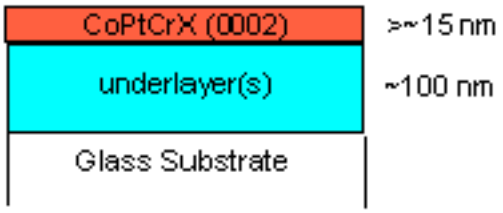
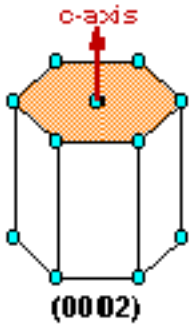
Perpendicular Media



- avoids (for sometime) superparamagnetism
- thicker magnetic media
- magnetic stability
- larger signal to head





Summary

Magnetic recording disks overview
media requirements & structures
Texture Measurements
Examples of Texture Effects
metal disks (1120)
glass disks - NiAl (1010)
glass disk - novel (1120)
perpendicular

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