



Norsam Technologies, Inc.

Ultra-High Density  
Analog and Digital Data Storage

# Digital and Analog Technology





# Norsam HD-Rosetta Technology

A complete solution to near- and very long-term archival storage needs.

# Archival Needs and Problems

- Archival Worthiness
- Storage Space
- Accessibility
- Format consistency

# Analog Market

- AIIM Estimates \$7.5 Billion Microfilm Market in 1994
- Freeman Associates Estimates \$35 Billion Market for Norsam Technology
- Government, Banks, Historical Organizations: On-, Near- and Off-Line

# Current Solutions, Limitations

- Paper
- Microfilm, Microfiche
- Digitization

# Limitations to Current Methods

## ■ Comparative Weights and Volumes of Archived Data

NORSAM Weight	NORSAM Volume	Fiche weight	Fiche volume	Paper weight	Paper volume
348 lb.	0.63 ft <sup>3</sup>	93 lbs.	1 ft <sup>3</sup>	10,200 lb.	206 ft <sup>3</sup>
196 lb.	0.35 ft <sup>3</sup>	(Invariant)	(Invariant)	(Invariant)	(Invariant)
64 lb.	0.12 ft <sup>3</sup>	"	"	"	"
3.1 lb.	.005 ft <sup>3</sup>	"	"	"	"
1.8 lb.	.003 ft <sup>3</sup>	"	"	"	"
.79 lb.	.001 ft <sup>3</sup>	"	"	"	"
3.2 oz.	0.6 in <sup>3</sup>	"	"	"	"
0.8 oz.	0.2 in <sup>3</sup>	"	"	"	"

## ■ Environmental Controls. Media Degradation.

# Microfilm

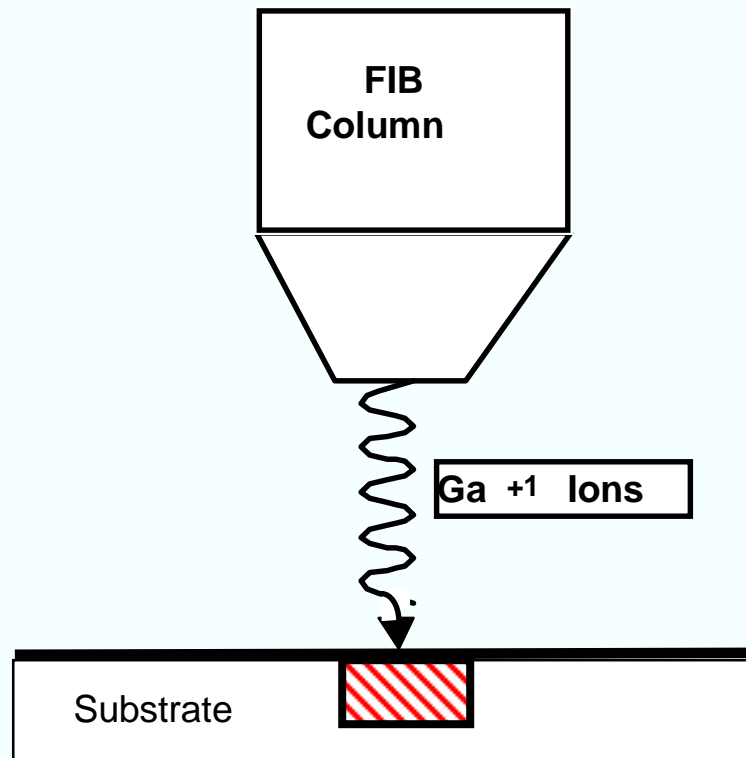
- Microfilm Storage Costs: \$3,000/Year per Million Images
- Lifetime Limits: Microfilm = 100 Years  
CDs = 50 Years      Paper = 100 Years



# Focused Ion Beam Technology for High Density Archival Storage

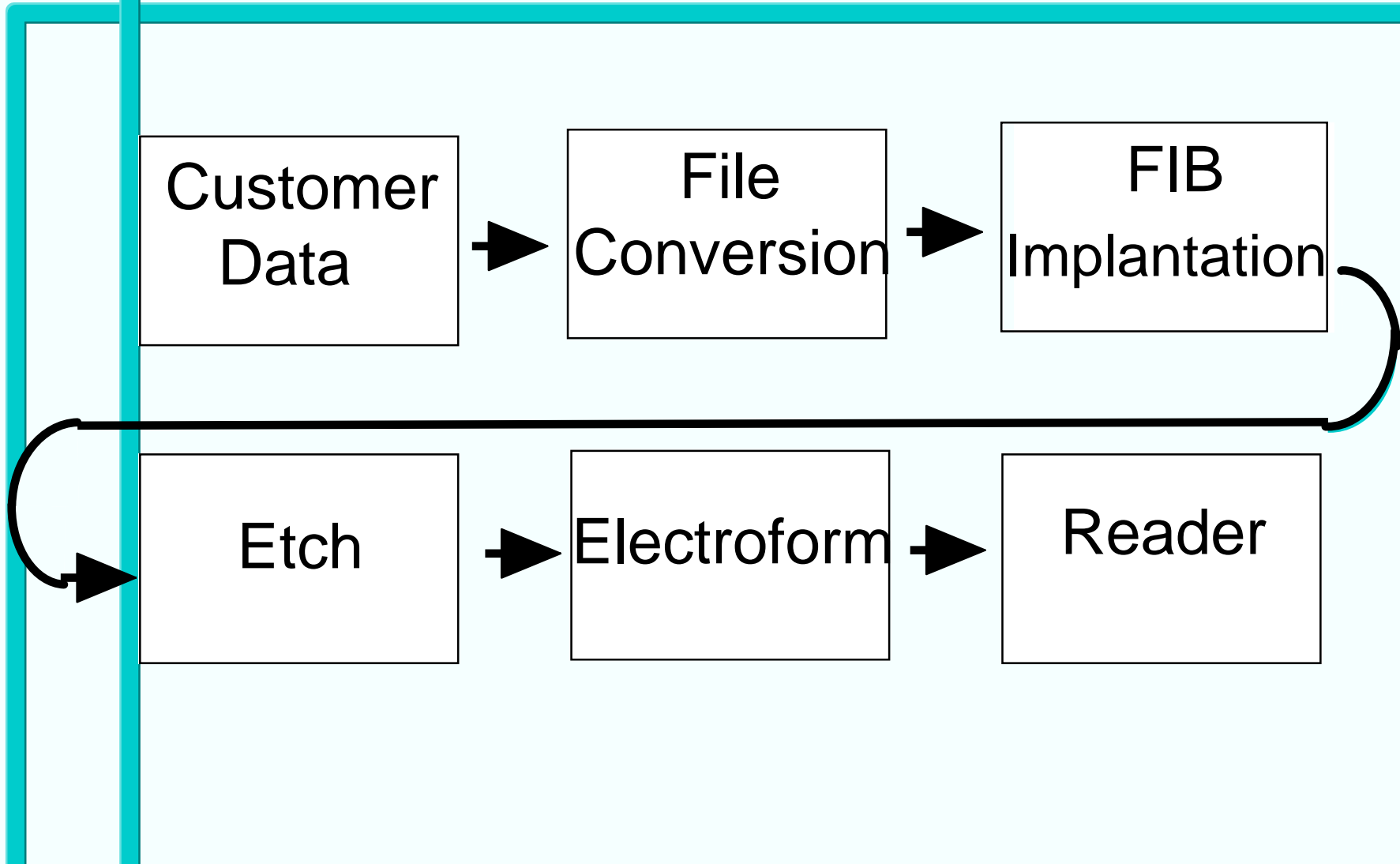
- Breakthrough technology
- Addresses all archival needs

# Focused Ion Beam Technology

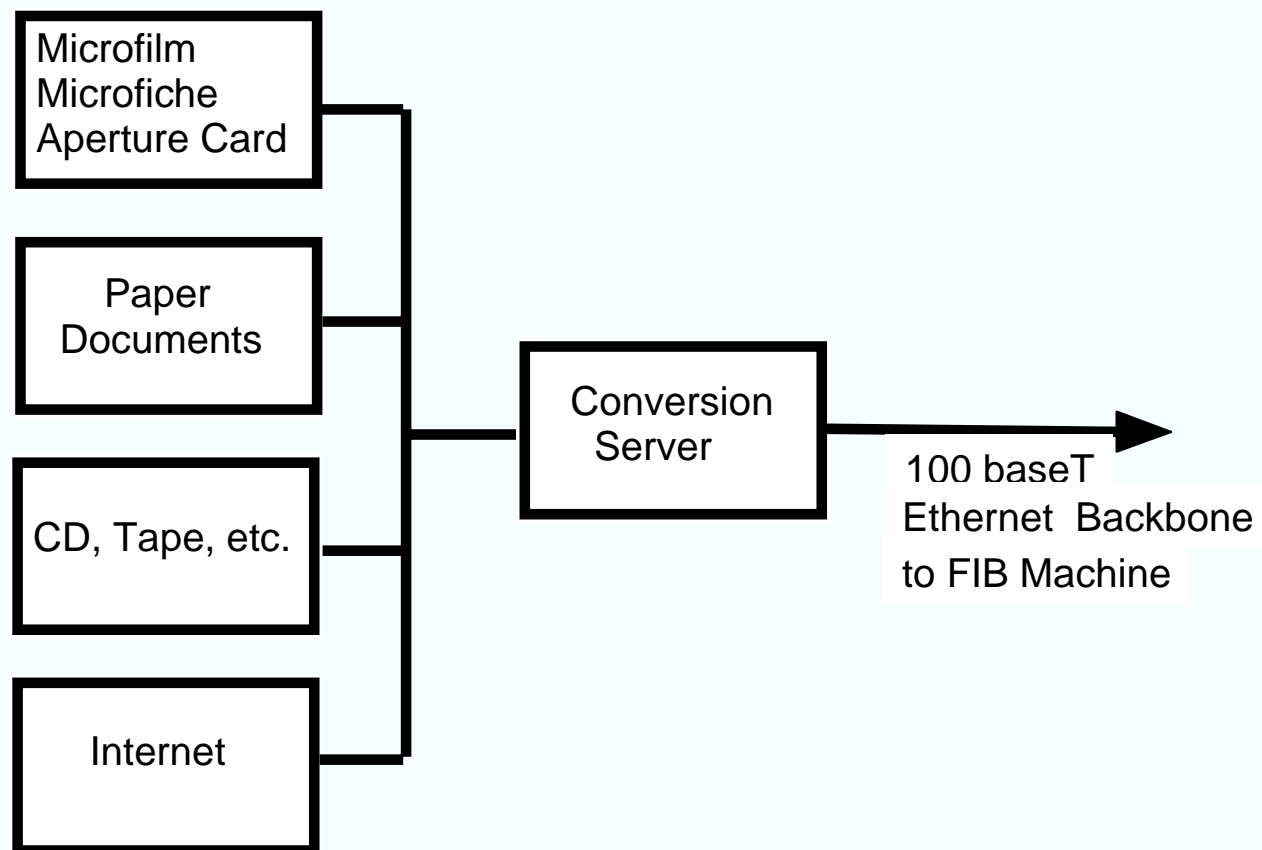


- Probe size 10 nm
- Precise positioning
- Complete Automation

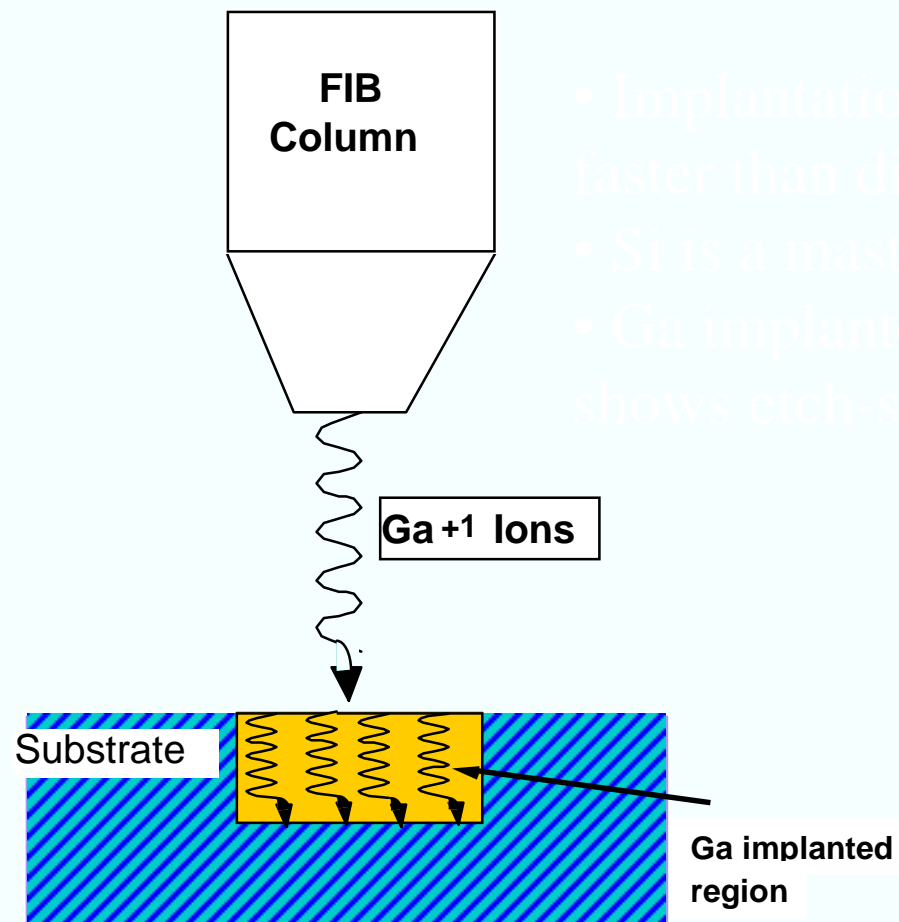
# Outline of Write Process



# Write Process: Data Conversion

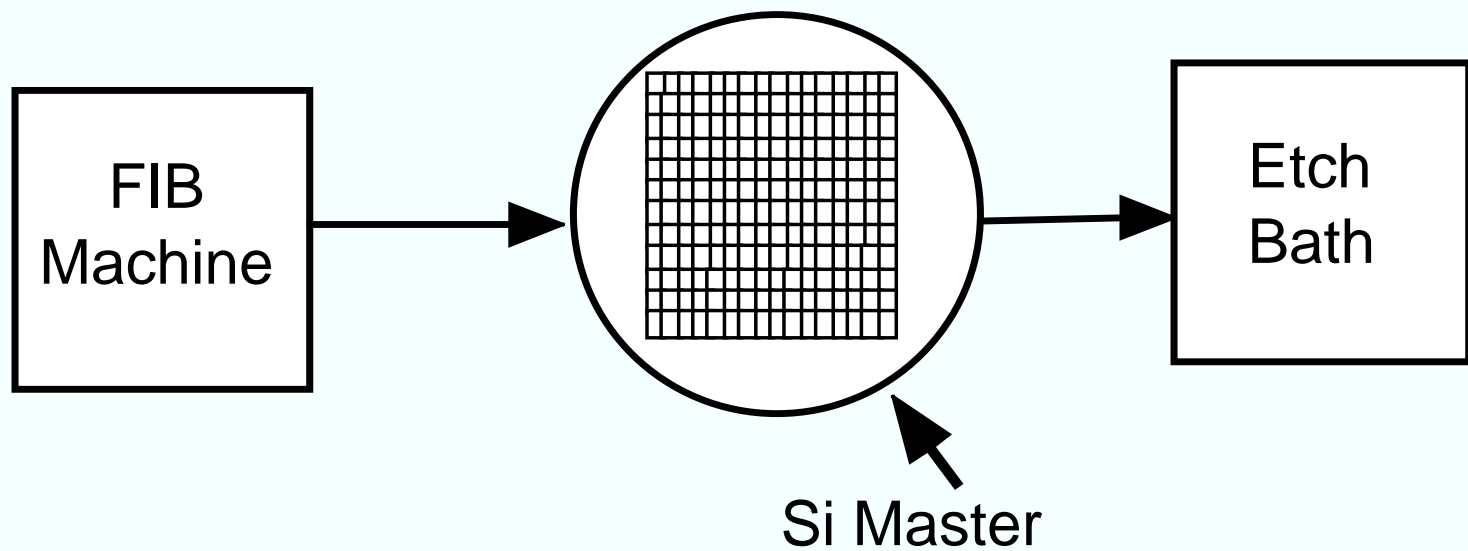


# Implantation



- Implantation is > 1000 faster than direct milling
- Si is a master substrate
- Ga implanted region shows etch-stop behavior

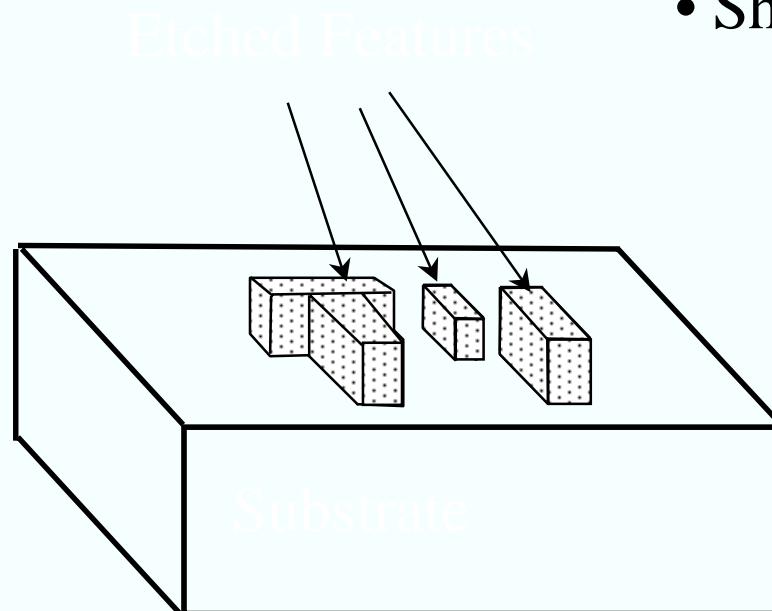
# Etching



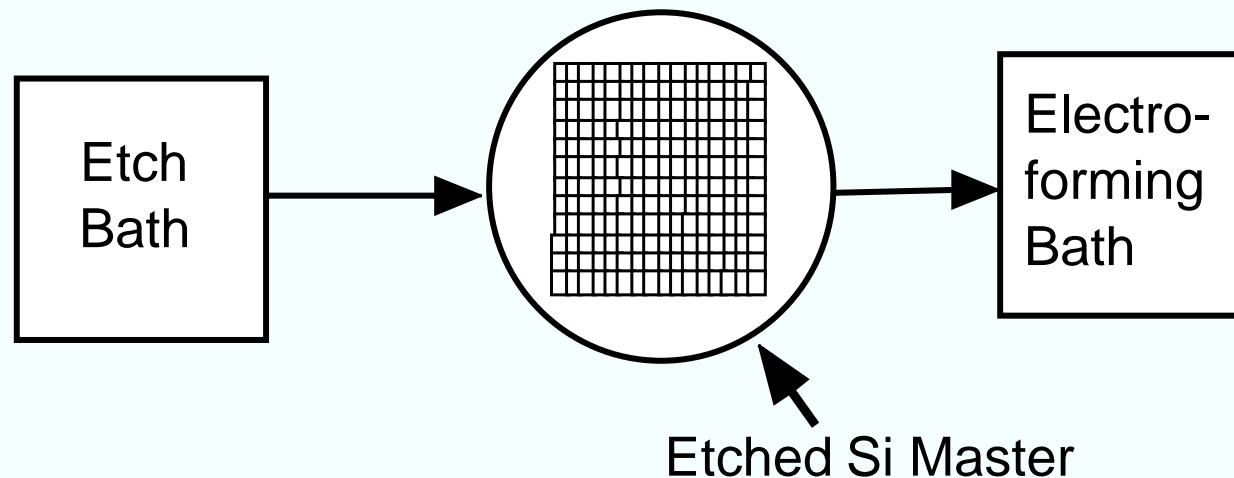
NOTE: MAYBE SHOW A REAL Si MASTER NOW

# Etching (cont)

- Implanted regions etch slower
- Etch rate is function of dose
- Short etch times, batch process



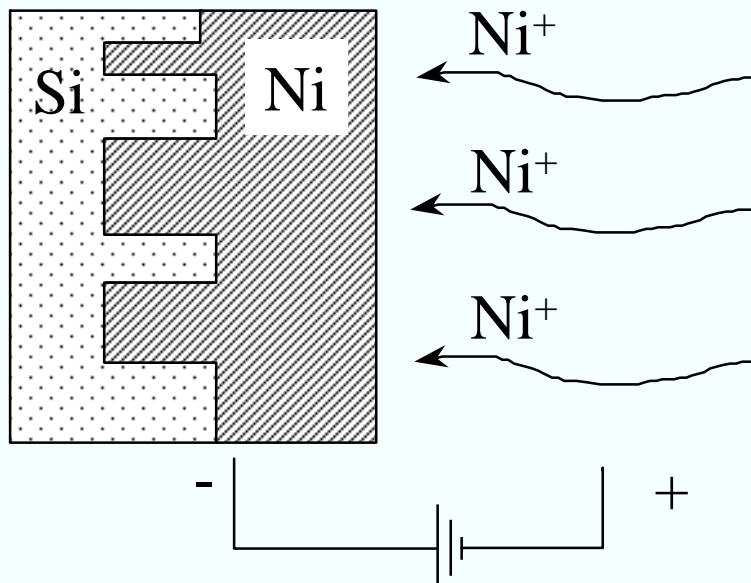
# Electroforming into Archival Substrate



- Si is not archival due to inherent brittleness
- Electroforming allows extremely accurate transfer of data into other, archival media
- CD/DVD manufacturing depends upon this process

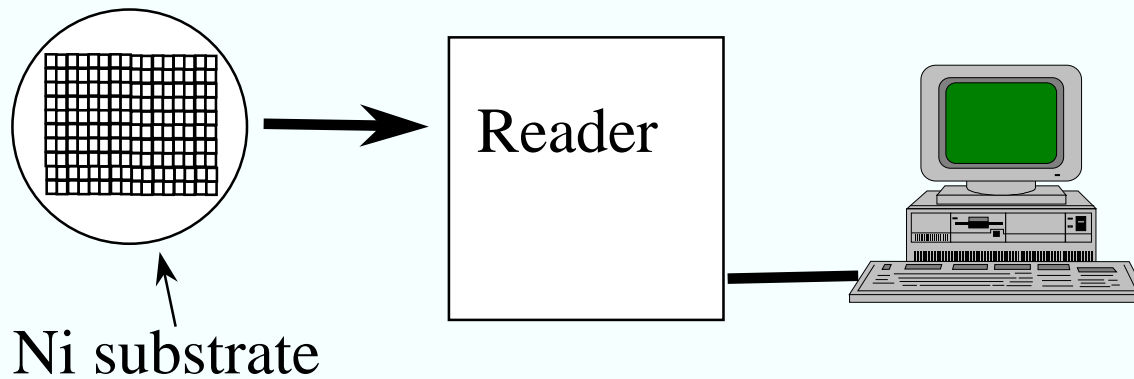


# Electroforming (cont.)



- Nickel is tough, strong, and corrosion resistant
- Electroforming is rapid, accurate, and low cost
- Archival substrate is  $\approx 200 \mu\text{m}$  thick

# Readback of Data



- PC Controlled
- Full Search and Index Capable

# Capacities

Number of Pages per Wafer as a Function of Pixel Size

Pixel Size	Page Size*	2" WAFER	8" WAFER
0.2 micron	0.66 x 0.50 mm	5837	95615
0.1 micron	0.33 x 0.25 mm	23725	383943
50 nanometer	0.17 x 0.13mm	95640	1538770
25 nanometer	0.08 x .06 mm	384092	6160951

\* 8 1/2 x 11 Page @ 300 dpi

# Summary

- HD-Rosetta Discs may be manufactured out of extremely durable materials, such as nickel. It survives most fires, is nonmagnetic, and will not be affected by electromagnetic pulses or radio frequencies.
- HD-ROM is currently capable of storing up to 700 times the capacity of current 4.75" CD.
- These capabilities establish HD-ROM as the densest and safest practical form of archival data storage in existence and provides unprecedented potential for large scale data users and archivists.

# HD-ROM

- High Density Read Only Memory
- Electron Beam Writer
- Near Field Optical Reader

# HD-ROM Specifications

- 50 nm pit size
- 165 GB per 120 mm disc.
- 15 msec access time
- Write rates 20 - 50 Mbytes per second
- Read rates 6 - 10 Mbytes per second

# Electron Beam Writing

- Norsam will partner with ebeam company
- Beam blanker speed
- Photoresist sensitivity
- Stage design

# SIAM Reader

- Scanning Interferometric Apertureless Microscopy
- Developed at IBM Yorktown
- Norsam has signed exclusive joint development and know-how agreement with IBM



# SIAM Reader

- Microscope produces diffraction limited laser spot
- Tip-sample interactions produce scattered waves.
- Phase changes define feature
- 1 nm resolution
- 6 Mbytes ps initial read rate, 10 Mbytes per second read rate projected
- Flying Head design
- < \$1000
- Compact footprint

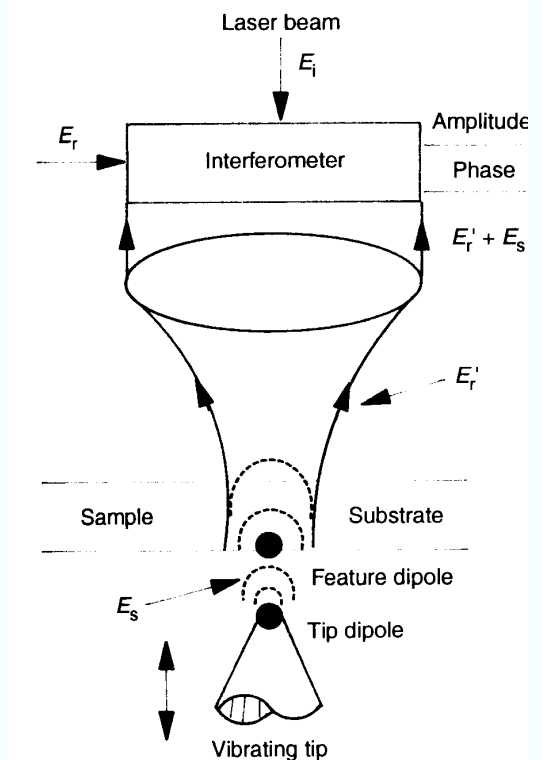


Fig. 1. Principle of the SIAM method.

1084

F. Zenhausern, Y. Martin,  
H.K. Wickramasinghe,  
Science, v. 269, 1083 (1995).

# Summary

- HD-Rosetta is near production.
- Preliminary contracts with NLM and others.
- HD-ROM: 24 month development time projected
- Combined technologies has advantages for archivists and large databases.