



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 ³	93 lbs.	1 ft ³	10,200 lb.	206 ft ³
196 lb.	0.35 ft ³	(Invariant)	(Invariant)	(Invariant)	(Invariant)
64 lb.	0.12 ft ³	"	"	"	"
3.1 lb.	.005 ft ³	"	"	"	"
1.8 lb.	.003 ft ³	"	"	"	"
.79 lb.	.001 ft ³	"	"	"	"
3.2 oz.	0.6 in ³	"	"	"	"
0.8 oz.	0.2 in ³	"	"	"	"

■ Environmental Controls. Media Degradation.

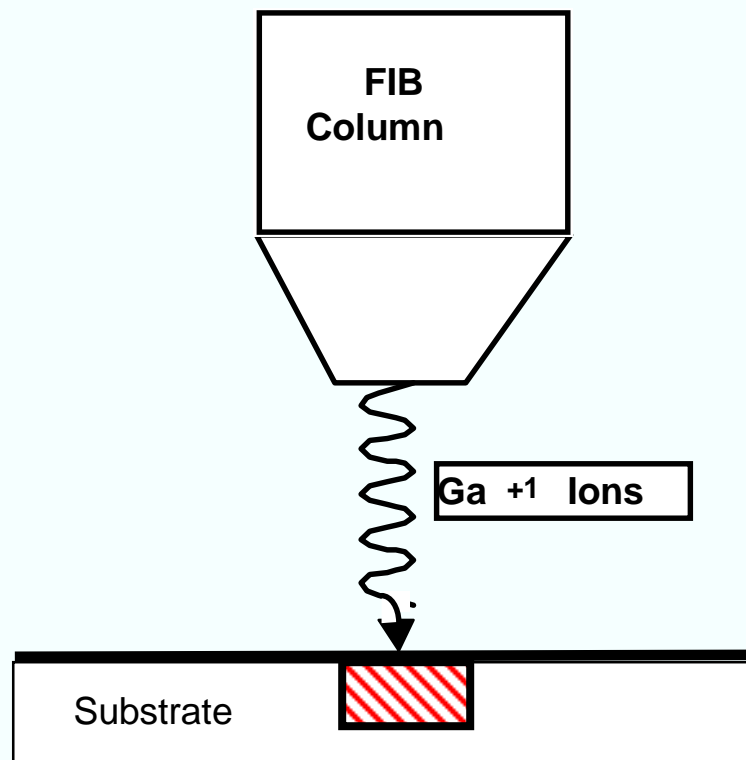
Microfilm

- 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

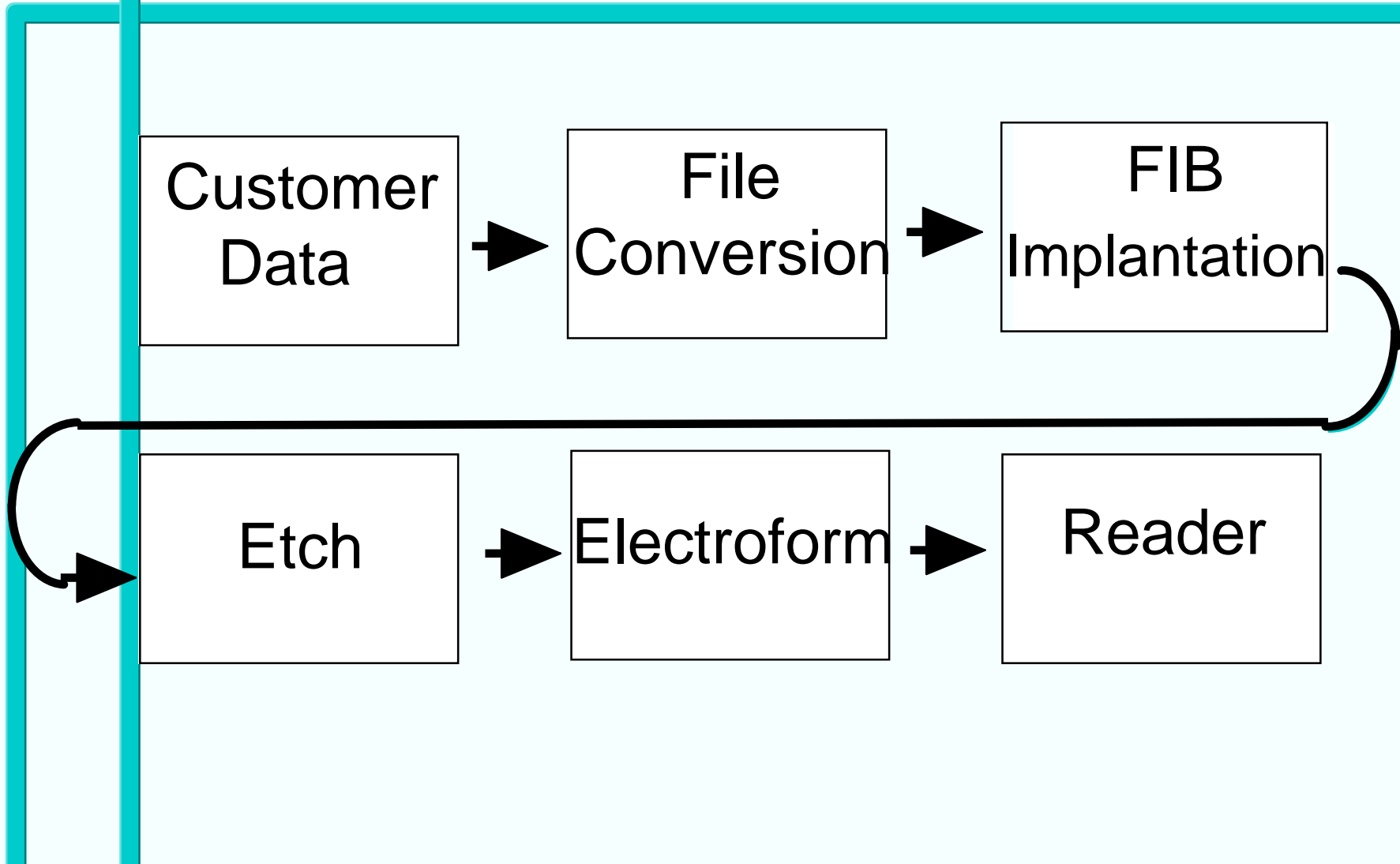
- Breakthrough technology
- Addresses all archival needs

Focused Ion Beam Technology

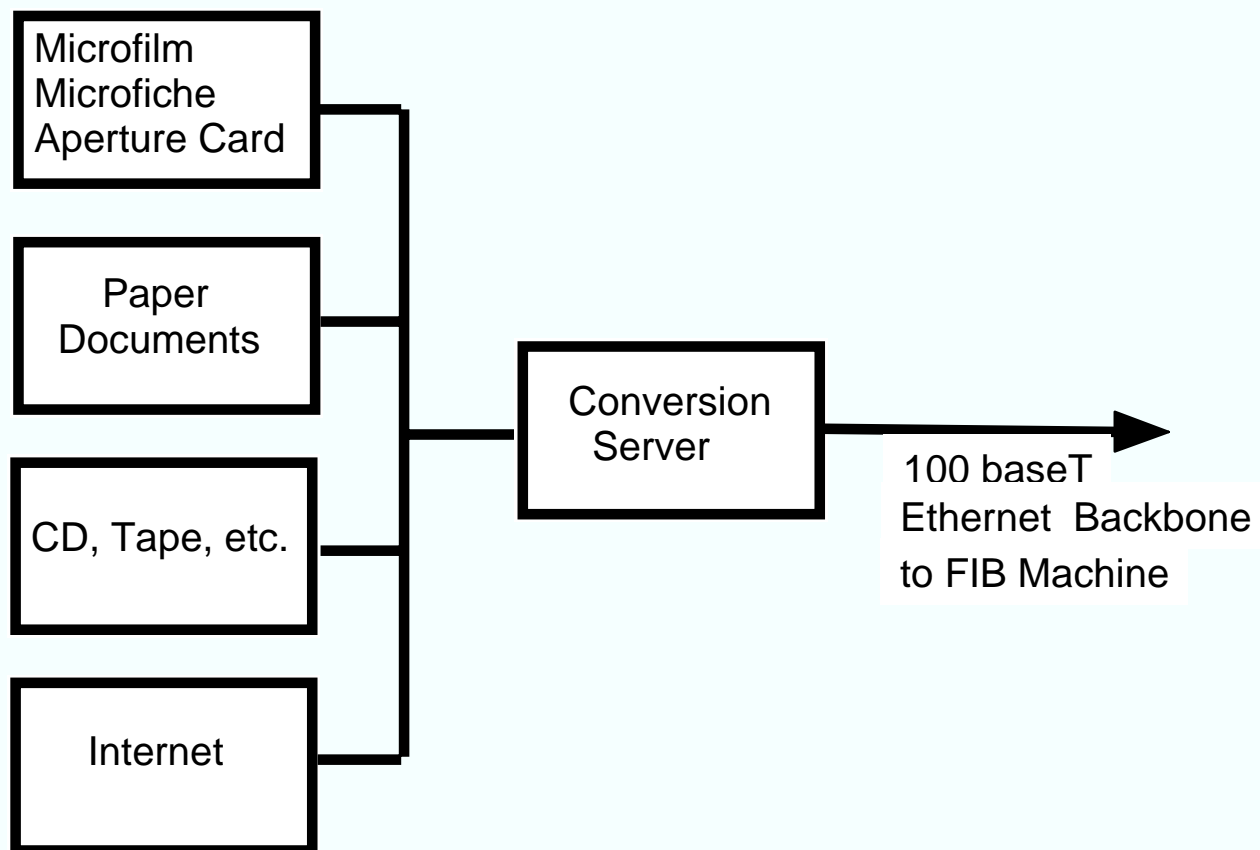


- Probe size 10 nm
- Precise positioning
- Complete Automation

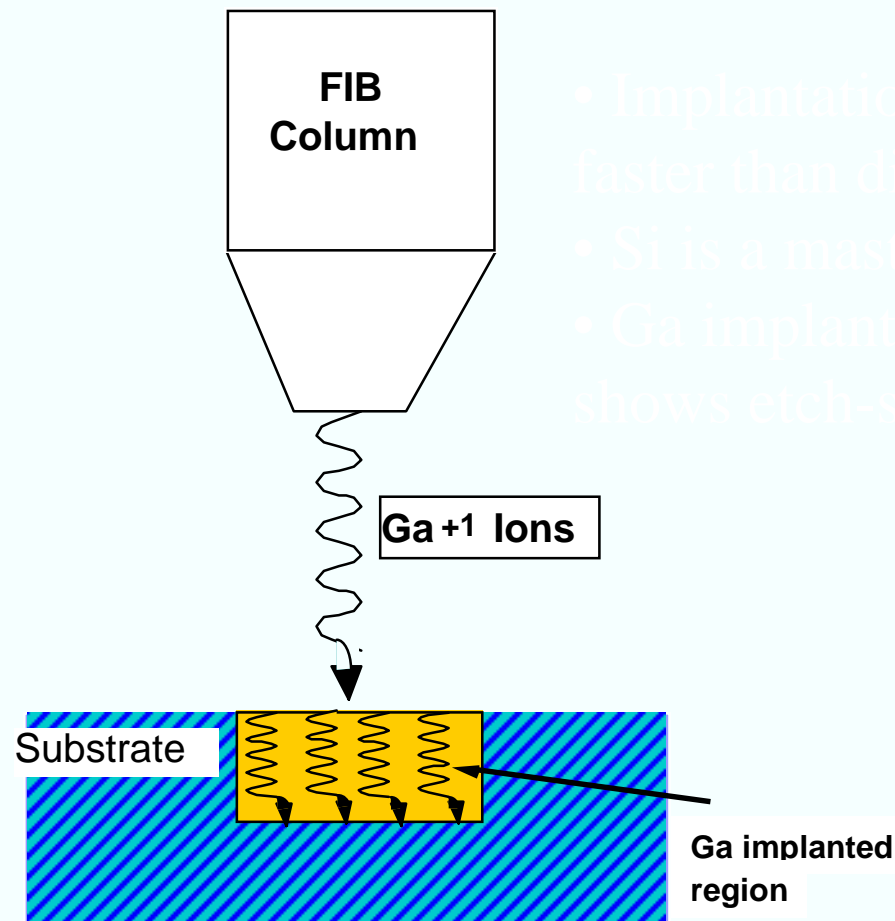
Outline of Write Process



Write Process: Data Conversion

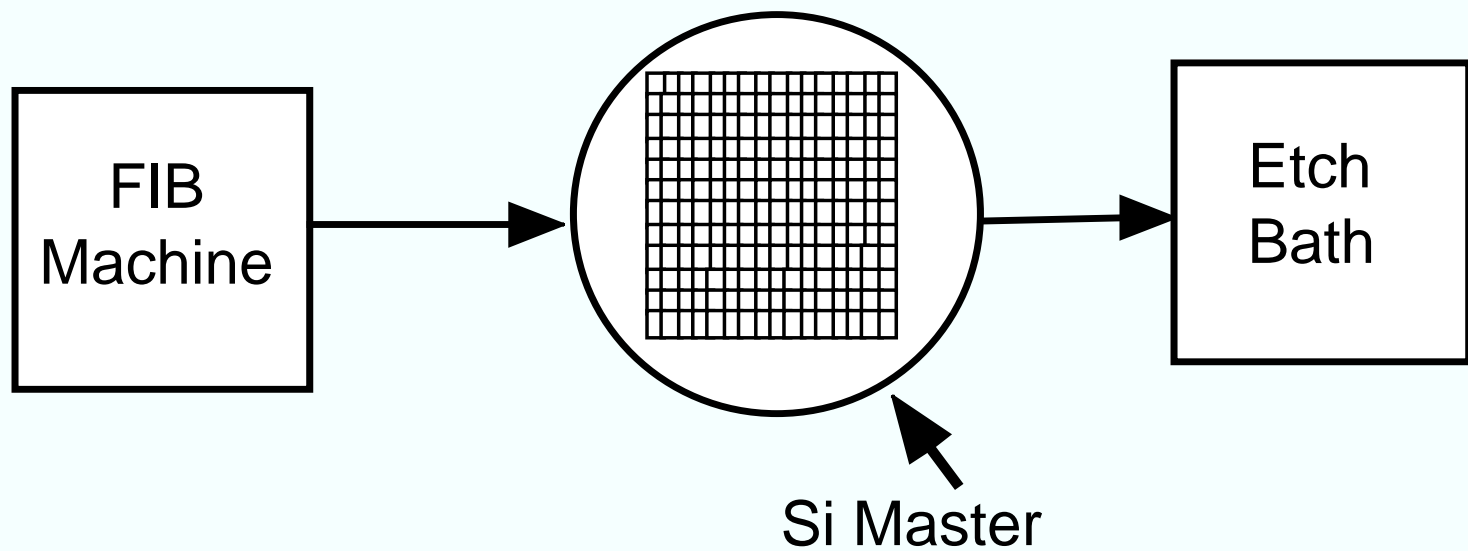


Implantation



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

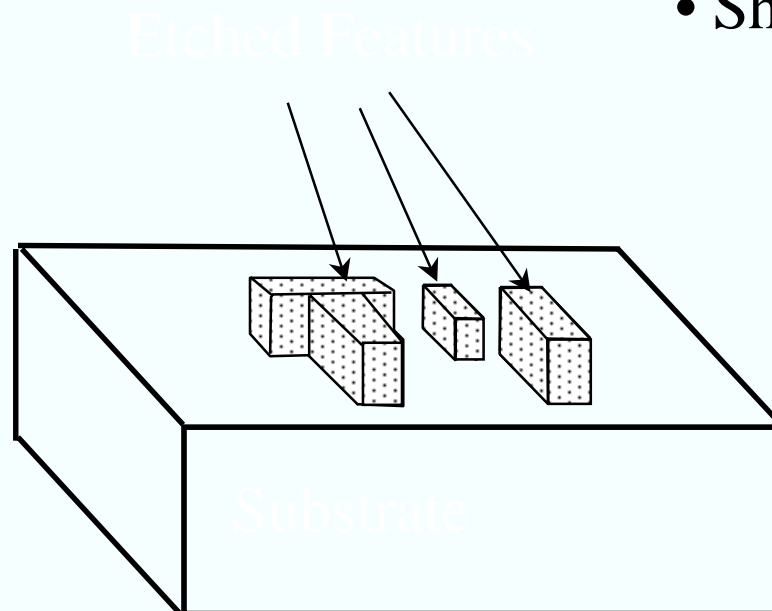
Etching



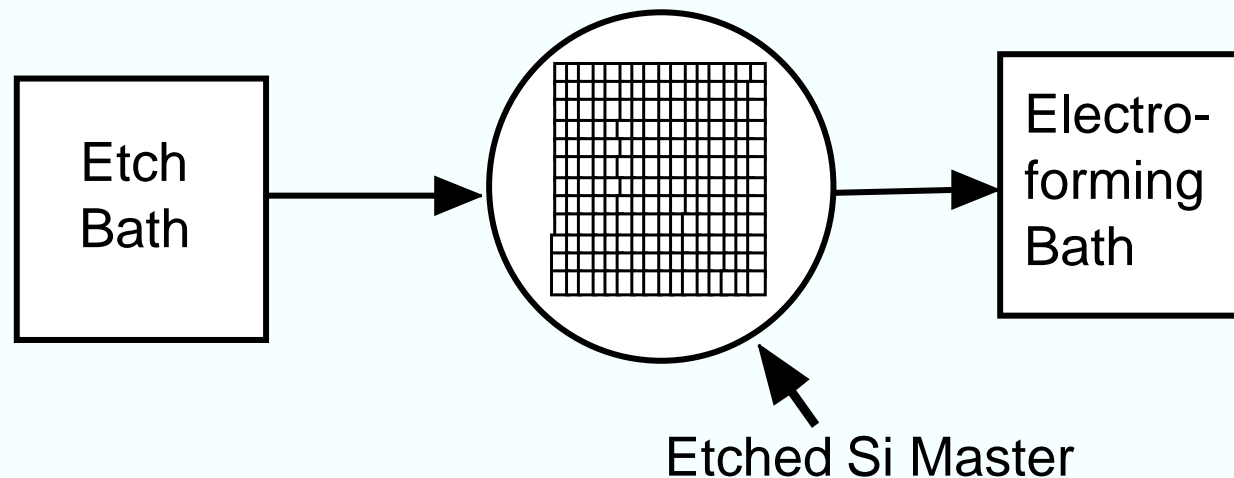
NOTE: MAYBE SHOW A REAL Si MASTER NOW

Etching (cont)

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

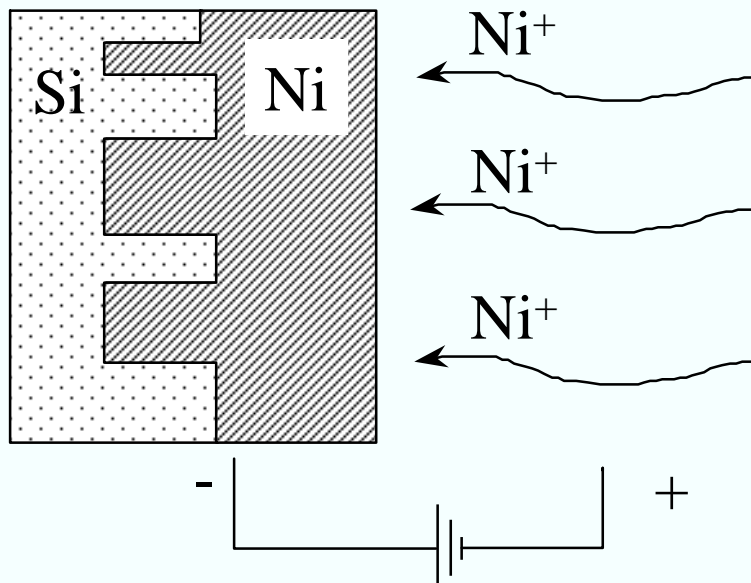


Electroforming into Archival Substrate



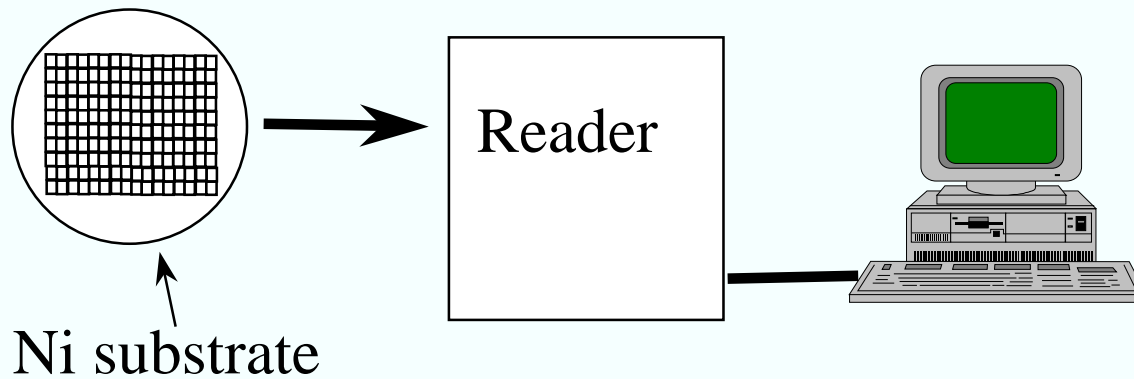
- Si is not archival due to inherent brittleness
- Electroforming allows extremely accurate transfer of data into other, archival media
- CD/DVD manufacturing depends upon this process

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

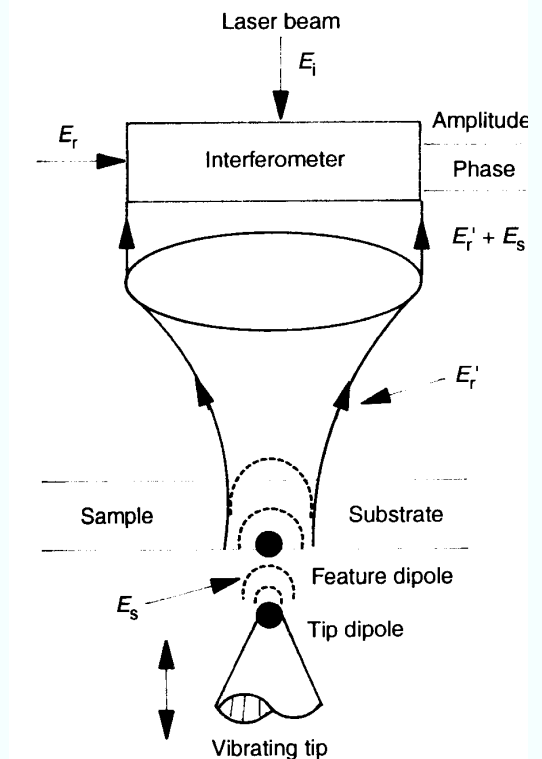


Fig. 1. Principle of the SIAM method.

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.