Norsam Technologies, Inc.

Ultra-High Density
Analog and Digital Data Storage
Digital and Analog Technology

HD-ROM  Charged particle technology  HD-Rosetta
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

<table>
<thead>
<tr>
<th>NORSAM Weight</th>
<th>NORSAM Volume</th>
<th>Fiche Weight</th>
<th>Fiche Volume</th>
<th>Paper Weight</th>
<th>Paper Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>348 lb.</td>
<td>0.63 ft³</td>
<td>93 lbs.</td>
<td>1 ft³</td>
<td>10,200 lb.</td>
<td>206 ft³</td>
</tr>
<tr>
<td>196 lb.</td>
<td>0.35 ft³</td>
<td>(Invariant)</td>
<td>(Invariant)</td>
<td>(Invariant)</td>
<td>(Invariant)</td>
</tr>
<tr>
<td>64 lb.</td>
<td>0.12 ft³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>3.1 lb.</td>
<td>.005 ft³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>1.8 lb.</td>
<td>.003 ft³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>.79 lb.</td>
<td>.001 ft³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>3.2 oz.</td>
<td>0.6 in³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>0.8 oz.</td>
<td>0.2 in³</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

### 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

Customer Data → File Conversion → FIB Implantation

Etch → Electroform → Reader
Write Process: Data Conversion

- Microfilm
- Microfiche
- Aperture Card
- Paper Documents
- CD, Tape, etc.
- Internet

Conversion Server

100 baseT Ethernet Backbone to FIB Machine
Implantation

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

FIB Machine → Si Master → Etch Bath

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 ≈ 200 µm thick
Readback of Data

- PC Controlled
- Full Search and Index Capable

Ni substrate
## Capacities

Number of Pages per Wafer as a Function of Pixel Size

<table>
<thead>
<tr>
<th>Pixel Size</th>
<th>Page Size*</th>
<th>2” WAFER</th>
<th>8” WAFER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2 micron</td>
<td>0.66 x 0.50 mm</td>
<td>5837</td>
<td>95615</td>
</tr>
<tr>
<td>0.1 micron</td>
<td>0.33 x 0.25 mm</td>
<td>23725</td>
<td>383943</td>
</tr>
<tr>
<td>50 nanometer</td>
<td>0.17 x 0.13 mm</td>
<td>95640</td>
<td>1538770</td>
</tr>
<tr>
<td>25 nanometer</td>
<td>0.08 x .06 mm</td>
<td>384092</td>
<td>6160951</td>
</tr>
</tbody>
</table>

* 8 1/2 x 11 Page @ 300 dpi
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

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.