ProTeM

Probe-based Terabit Memory

www.protem-fp6.org

ProTeM

An EU FP6 Integrated Project funded by the IST Micro- and Nanosystems programme

Funding - 5,298,510 €

Budget - 9,627,544 €

Start date - 1st October 2006

Duration - 4 years

Aim

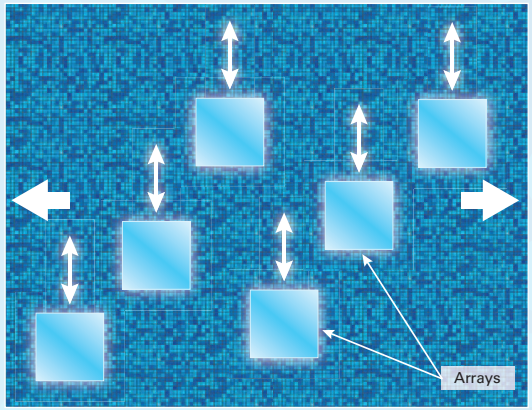
To develop probe storage micro-nano techniques and systems for ultra-high-capacity, low power, small form-factor memories, with a particular focus on archival and back-up applications.

Vision

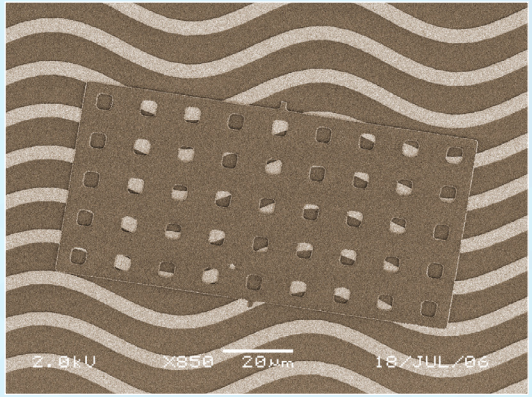
Ultra-high storage densities (1 to 10 Tbit/in^2), ultra-high capacities (20 TBytes in CD-sized area), media, system lifetimes and data rates suitable for archival and backup storage.

Positioning

For archiving applications, the probe array has to be positioned over an area as large as 100 cm^2 with a precision of nanometers. This requires completely new architectures in positioning. Key design parameter is the overall reliability of the the system.



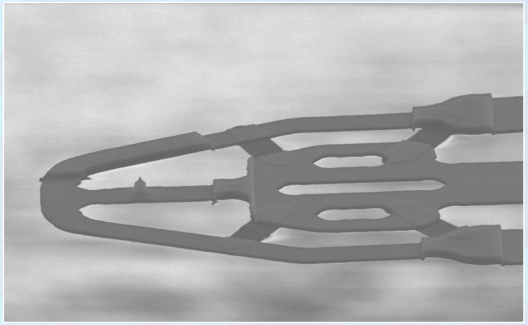
Possible architecture where several arrays move linearly over the medium surface.



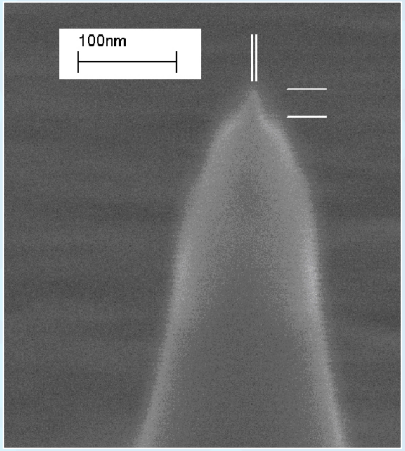
An electrostatic stepper actuator based on image charges could be used to displace the medium.

Probes

Advanced microprobes are developed with high endurance, high speed, high sensitivity and low-power consumption for polymer and phase-change media. ProTeM seeks to advance technology with state-of-the-art micro and nano-cantilever design and fabrication with the objectives of achieving high data rate, improved power consumption and low tip wear.



SEM Image of a thermomechanical microcantilever with read and write heaters and an ultra-sharp tip.



Encapsulated tip with a conducting silicon core surrounded by an oxide layer to prevent wear, useful for phase-change based probe storage.

Partners

- IBM Zurich CH
- CEA-LETI F
- ST Microelectronics I
- RWTH-Aachen G
- Plasmon Data Systems UK
- Arithmatica UK
- University of Twente NL
- Fraunhofer Gesellschaft D
- University of Exeter UK
- ALMA Consulting Group F

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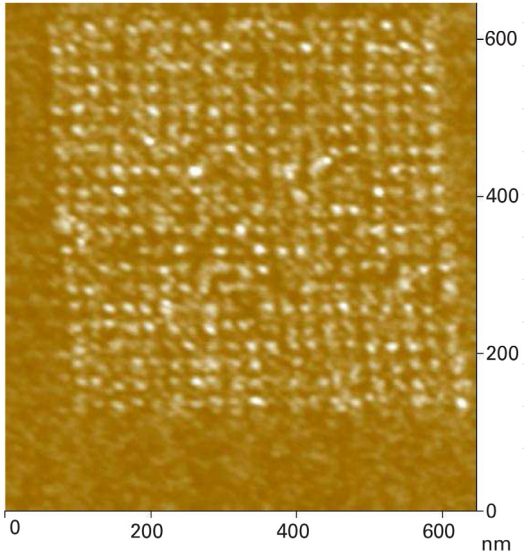
Media

Two types of media are being addressed. Data is stored in polymer media by pressing indentations with a heated tip. Research is being performed on higher densities, and thermal stability. In phase-change media crystalline bits are defined in amorphous film by passing a current from the tip to the medium. While feasibility of 1Tbit/in^2 on a $Ge_2Sb_2Te_5$ thin film has already been demonstrated, media optimization needs to address tribology, archival lifetime and erasability issues.

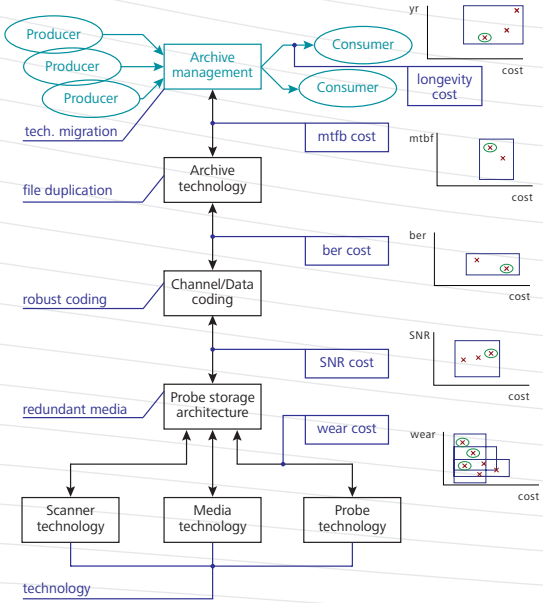
Data stored in a highly cross-linked high temperature polymer at a density of 2 Tb/in^2 corresponding to a line and indent pitch of 21 nm.



Conductive AFM image of 20x20 crystalline dot array with 25 nm pitch.

System

Crucial performance specifications, such as reliability, data rate and power consumption are optimized using a conceptual framework. Advanced error coding techniques are used to ensure that data can be read back after 40 years, even after failure of probes.



The overall ProTeM architecture is modeled in a conceptional framework.

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