Nanodots Breakthrough Promises 'Library On A Chip'

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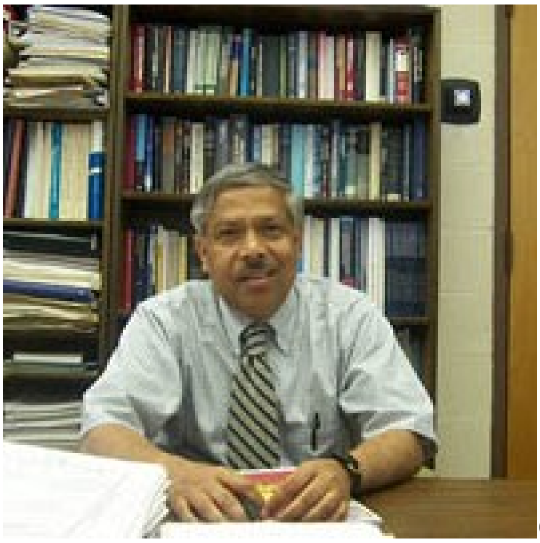(NCSU [1]) - A researcher at North Carolina State University has developed a computer chip that can store an unprecedented amount of data – enough to hold an entire library's worth of information on a single chip. The new chip stems from a breakthrough in the use of nanodots, or nanoscale magnets, and represents a significant advance in computer-memory technology.

"We have created magnetic nanodots that store one bit of information on each nanodot, allowing us to store over one billion pages of information in a chip that is one square inch," says Dr. Jay Narayan, the John C. Fan Distinguished Chair Professor of Materials Science and Engineering at NC State and author of the research.

The breakthrough is that these nanodots are made of single, defect-free crystals, creating magnetic sensors that are integrated directly into a silicon electronic chip. These nanodots, which can be made uniformly as small as six nanometers in diameter, are all precisely oriented in the same way – allowing programmers to reliably read and write data to the chips.

The chips themselves can be manufactured cost-effectively, but the next step is to develop magnetic packaging that will enable users to take advantage of the chips – using something, such as laser technology, that can effectively interact with the nanodots.

The research, which was funded by the National Science Foundation, was presented as an invited talk April 7 at the 2011 Materials Research Society Spring Meeting in San Francisco.

NC State's Department of Materials Science and Engineering is part of the university's College of Engineering.

The study abstract follows:

"Self Assembly of epitaxial magnetic nanostructures"

Author: J. Narayan, North Carolina State University

Presented: April 7, 2010, 2011 MRS Spring Meeting, San Francisco

Abstract: This talk focuses on self-assembly processing of magnetic nanodots such as Ni, Ni-Pt, Fe-Pt during thin film growth by pulsed laser deposition. This self-assembly can be extended from two-dimensional to three-dimensional structures by controlling stresses/strains in the layers of composite structures. Magnetic properties are found to be a strong function of size, shape, orientation and chemical ordering. The primary focus of this talk is on epitaxial orientation of nanodots and integration of microelectronic/nanoelectronic devices on Si(100)(1). The epitaxial orientation is controlled by TiN buffer layer grown epitaxially on Si(100), and results compared with randomly oriented nanodots formed using amorphous alumina buffer. The epitaxial structures (Ni, Ni-Pt, Fe-Pt)/TiN/Si(100) involve lattice misfit ranging from 8% to 22%, which can be handled by our domain epitaxy paradigm (2). The DME paradigm involves matching of integral multiples of lattice planes across the interface, as the strain relaxation occurs by dislocations which represent either missing or extra planes (2). We discuss the optimization of structure and atomic ordering in Ni-Pt and FePt structures and correlations with magnetic properties by controlling thin film processing parameters and annealing conditions.

Links:
[1] http://news.ncsu.edu