NEMS/MEMS built by heated AFM, nanolithography patterning at Georgia Tech

Medical Design Technology

TCNL uses a heated atomic force microscope (AFM) tip to produce patterns. The AFM-based litho process could build high-density, low-cost, complex ferroelectric structures, enabling energy harvesting arrays, sensors, and nano-electromechanical systems (NEMS) and micro-electromechanical systems (MEMS).

Fig1: Suenne Kim, Georgia Tech postdoctoral fellow, holds a sample of flexible polyimide substrate used in the heated AFM TCNL research. Assistant professor Nazanin Bassiri-Gharb and graduate research assistant Yaser Bastani are also featured. Credit: Gary Meek.

[1] Fig2: The topography
The piezoelectric materials can be made into precise shapes and deposited accurately on a flexible substrate, said Nazanin Bassiri-Gharb, assistant professor, Georgia Tech School of Mechanical Engineering. The structures were "directly grown with a CMOS-compatible process" at the smallest resolution acheived to-date, Bassiri-Gharb adds, pointing out that lower-temperature processing isn't the only benefit to the process. Wires were built to 30nm wide; spheres were made with 10nm diameters.

Fig2: The topography (by AFM) of a ferroelectric PbTiO3 (PTO) line array crystallized on a 360nm-thick precursor film on polyimide. Scale bar = 1um. Credit: Suenne Kim.

[2] Fig3: Scanning electron microscope.
The researchers envision ferroelectric memory applications, depositing spheres at densities exceeding 200 gigabytes per square inch, said Suenne Kim, a postdoctoral fellow in laboratory of Professor Elisa Riedo in Georgia Tech's School of Physics.

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