Drawing data at the nanometer scale

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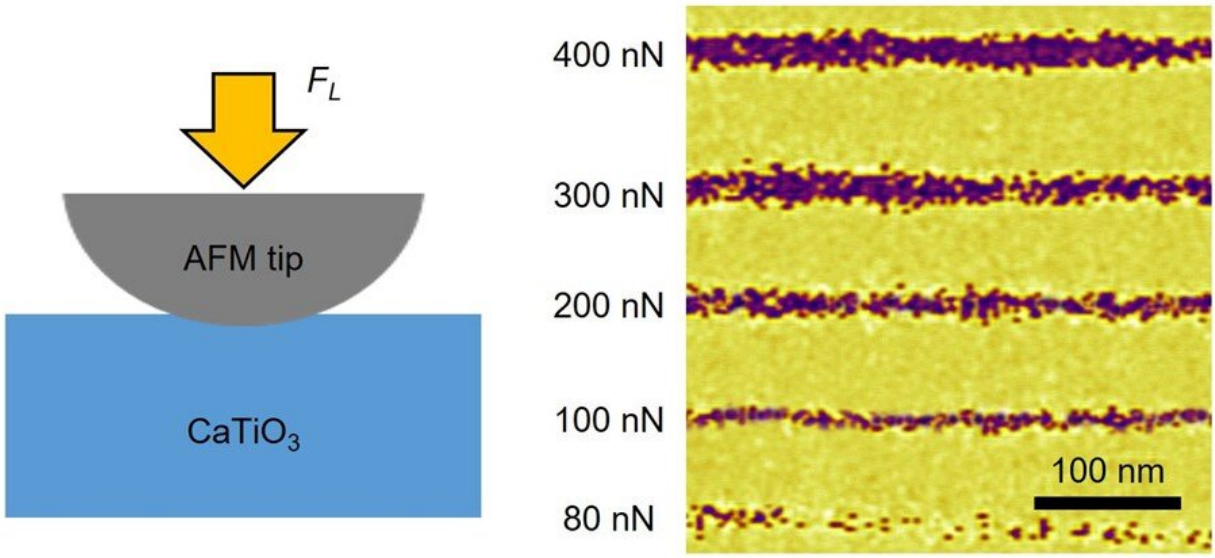

Left: Data storage using probe force. Right: Data storage area drawn with a width of 10 nm or less. Credit: POSTECH

A method to draw data in an area smaller than 10 nanometers has been proposed in a recent study published in *Physical Review Letters*

A joint research team led by Professor Daesu Lee (Department of Physics) of POSTECH, Professor Se Young Park (Department of Physics) at Soongsil University, and Dr. Ji Hye Lee (Department of Physics and Astronomy) of Seoul National University has proposed a method for densely storing data by "poking" with a sharp probe. This

method utilizes a material in the metastable state, whose properties change easily even with slight stimulation.

A thin film of metastable ferroelectric calcium titanate ($CaTiO_3$) enables the polarization switching of a material even with a slight pressure of a probe: A very weak force of 100 nanonewtons (nN) is more than enough. The joint research team succeeded in making the width of the polarization path smaller than 10 nm by using this force and found the way to dramatically increase the capacity of data storage. This is because the smaller the size of the path, the more data the single material can store.

The data storage capacity increased by up to 1 terabit (Tbit)/cm as a result of drawing the data storage area using a probe on the thin film. This result is 10 times greater than that of a previous study (0.11 $Tbit/cm^2$) which suggested a probe-based storage method using another material. Unlike the data storage method that uses electric fields, this probe method only requires a very small force, so the burden on the device is also small.

The results from the study are drawing attention as they have proved that materials achieve higher performance in an unstable metastable state. The findings are anticipated to be applicable in next-generation electronic devices with improved integration and efficiency in the future.

More information: Ji Hye Lee et al, Flexoelectricity-Driven Mechanical Switching of Polarization in Metastable Ferroelectrics, *Physical Review Letters* (2022). DOI: 10.1103/PhysRevLett.129.117601

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