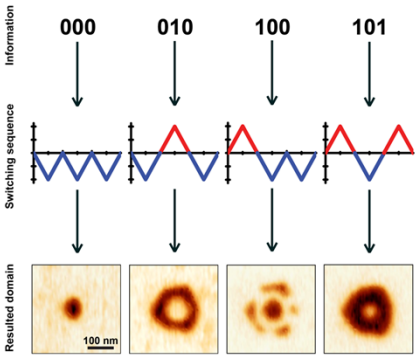
# Interplay between polarization and screening charge dynamics enables novel data storage approach




Data storage approach based on coding of information in the shapes and sizes of the ferroelectric domains. Top shows the numerical combination, corresponding sequence of electrical pulses and resulting domain structure.

Work performed as staff science at ORNL's Center for Nanophase Materials Sciences, in collaboration with the National Academy of Sciences of Ural and the Ural Federal University, Russia.

## Scientific Achievement

**Formation of spatially inhomogeneous symmetric and asymmetric domain structures were induced by polarization switching via a nanometer-scale tip of a scanning probe microscope.**

## Significance and Impact

**The observed phenomena can be used in development of novel data storage devices where information is coded by shape and size of the nano-sized domains.**

## Research Details

- Polarization switching achieved by a series of positive and negative triangular pulses using a scanning probe microscope.
- Formation of symmetric and asymmetric spatially inhomogeneous domain structures has been observed.

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Ferroelectric single crystals with tailored domain structure are a promising material for the development of new generation of optical, acoustic and data storage devices. Therefore, approaches that lead to the control of polarization switching, and of the dynamics thereof, with nanometer spatial resolution are of immense scientific importance. Scanning probe microscopy (SPM) provides wide range of tools for complex investigations of the ferroelectric domain structures and processes of polarization reversal. In this work the kinetics of SPM tip-induced polarization reversal on the surface of a $LiNbO_3$ single crystal has been studied. The formation of spatially inhomogeneous symmetric and asymmetric nano-sized domain structures has been revealed; it is attributed to a complex multistage process including "anomalous" polarization reversal in the direction opposite to the applied electric field. This phenomena is expected to form the basis for a novel approach of data storage based on ferroelectric domain structures.

**Reference**

"Ionic field effect and memristive phenomena in single-point ferroelectric domain switching"
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