Ferroelectric single crystals with tailored domain structure are now widely using in acoustic, nonlinear optical and emergent data storage devices. As such, the investigation of the polarization reversal mechanisms on the level of a single domain is of immense scientific importance. Scanning probe microscopy (SPM) opens great opportunities for complex investigation of the ferroelectric domain structures and process of polarization reversal with nanometer spatial resolution.

In this work SPM tip induced writing of 1D domain chains has been studied on the surface of LiNbO$_3$ single crystal. A wide range of unexpected domain dynamics has been revealed including intermittency, quasiperiodicity and chaos. Observed phenomena have been explained by long-range interaction between neighboring domains in the chain due existence of spatially inhomogeneous partially unscreened depolarization field.

Explored domain behavior enables a new generation of memristive, memcapacitive and neuromorphic devices and potentially leads to new forms of information processing.

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