A novel method of storing data using the dielectric constant rather than electrical resistivity

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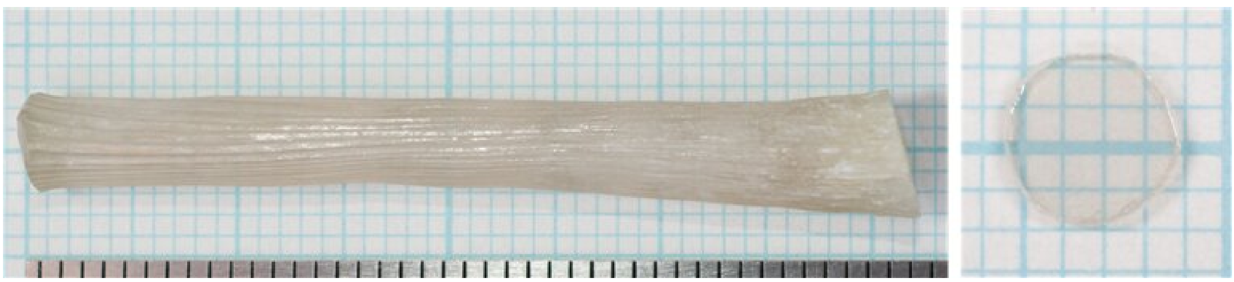

Barium Zirconate (BaZrO3) and its wafer (right). Credit: UNIST

A research team, affiliated with UNIST has unveiled a novel method of storing data using the dielectric constant, rather than the electrical resistivity. According to the research team, their findings are expected to open a new route to develop functional materials via manipulating defect-dipoles and offers a novel platform to advance heteroepitaxy beyond the prevalent perovskite substrates.

This breakthrough has been carried out by Professor Yoon Seok Oh and his research team in the Department of Physics at UNIST, in collaboration with Professor Tae Heon Kim from the University of Ulsan.

In this study, the research team developed a new substrate of cubic perovskite, $BaZrO_3$, which boosts the square-tensile-strain to $BaTiO_3$ and promotes four-variants in-plane spontaneous polarization with oxygen vacancy creation.

The fourfold symmetric square lattice and strain on the surface of the cubic perovskite $BaZrO_3$ substrate produce four variants of 100 in-plane electric polarization and the domain structures. The large tensile strain also induces built-in oxygen vacancies and defect-dipoles due to the unit cell expansion. As the strain-driven built-in defect-dipole cooperates with the four-variant domains of the in-plane polarization, the researchers found that the electrical poling process reversibly control the orientation of the built-in defect-dipoles and the ternary polar states, characterized by the biased/pinched hysteresis loops.

The development of four-variant polar domains of the $BaTiO_3$ on the $BaZrO_3$ substrate shows that the large isotropic surface lattice can spawn a novel ground state and physical phenomena in other inaccessible heterostructures, such as 2D topological phases of honeycomb superlattices on sixfold symmetric surface.

The $BaZrO_3$ substrate will be harnessed as a new platform for artificial design to a conceptual material system via heteroepitaxy inevitably combined with strain engineering. In addition, the switchable dielectric states provide evidence that the dielectric constant, rather than the electrical resistivity, can be considered a low-energy-consumption memory information.

The findings of this research have been published in the October 2022 issue of *Advanced Materials*.

More information: Jun Han Lee et al, Reversibly Controlled Ternary Polar States and Ferroelectric Bias Promoted by Boosting

Square-Tensile-Strain, *Advanced Materials* (2022). DOI: 10.1002/adma.202205825

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