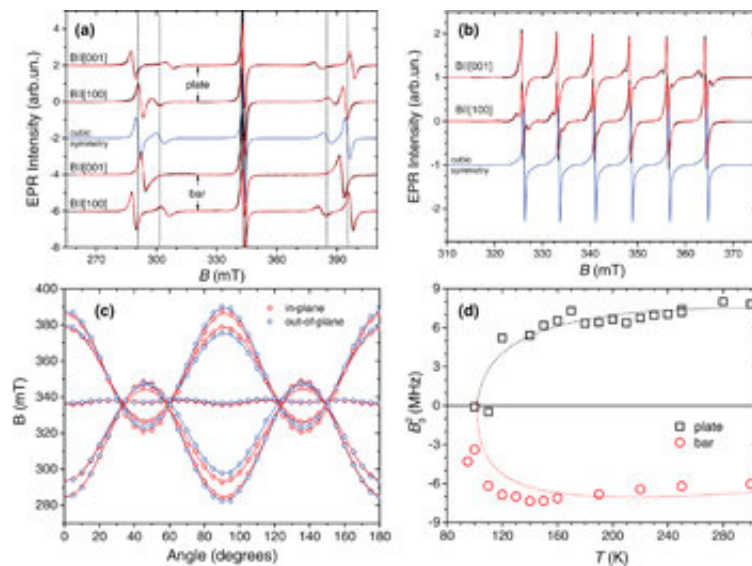


# New properties of strontium titanate are significant for electronics research

April 14 2021, by Yury Nurmeev



EPR spectra of the (001)-oriented single-crystal samples having the shape of a bar and a plate of STO:Fe<sup>3+</sup> at T = 300 K (a) and of a plate of STO:Mn<sup>4+</sup> at T = 150 K (b). The orientations of the samples with respect to the magnetic field B are marked in the figure. Black lines are the measured spectra, the red ones are the fits and the blue lines show the simulated spectra of the non-perturbed cubic-symmetry centers (see text). Orientation dependence of the resonance fields for the Fe<sup>3+</sup> centers in the STO:Fe (001)-plate (c) with the magnetic field rotated in the (001) and (100) crystallographic planes (rhombs and circles, respectively); its fit using the Hamiltonian (1) is shown by solid lines. Temperature dependences of the parameter corresponding to the axial component of the crystal field for a plate (squares) and a bar (circles) shaped samples (d); dotted lines are the guides for the eye. Credit: Kazan Federal University

While studying strontium titanate with electron paramagnetic resonance, a team from KFU's Center for Quantum Technology has found that the shape of a specimen of strontium titanate influences its internal symmetry. The research was co-conducted by the Ioffe Institute of Physics and Technology (Russia) and the Institute of Physics of the Czech Academy of Sciences.

At [room temperature](#),  $\text{SrTiO}_3$  is a crystal with high cubic symmetry, that is, the lattice of [strontium titanate](#), like bricks, is composed of unit cells, each of which is a regular cube. However, the researchers showed the picture is a bit more nuanced. In thin plates and columns measuring microns in width, the symmetry decreases to tetragonal (uniaxial), with a structure was not previously observed in  $\text{SrTiO}_3$ . That is, each elementary cell turns into a parallelepiped.

"The results are of great scientific and practical importance. In many cases, the scale of breaking is not as important as its very presence. A decrease in symmetry opens up the possibility of phenomena that are forbidden in a cubic structure," said Roman Yusupov, lead research associate of the Center for Quantum Technology.

He noted that strontium titanate is actively used in [thin-film technologies](#), where the functional properties of materials are determined by layers that sometimes have a thickness of several atoms. They are crucial for [electronic devices](#), such as processors, monitors, mobile screens, high-capacity batteries, and storage devices.

"Thin films are based on substrates—typically thin (less than one millimeter in thickness) slabs of materials other than the film material. The properties of thin films are largely determined by the structure of the substrate. One of the widely used substrate materials is strontium titanate," explains Yusupov.

By changing the distortion magnitude of substrates, it's possible to change the characteristics of [thin films](#) deposited on them, and thus contribute to creating new devices, sensors, and detectors.

**More information:** B. F. Gabbasov et al. Symmetry breaking in single-crystal SrTiO<sub>3</sub> plates: EPR manifestations, *EPL (Europhysics Letters)* (2021). [DOI: 10.1209/0295-5075/133/37002](https://doi.org/10.1209/0295-5075/133/37002)

Provided by Kazan Federal University

Citation: New properties of strontium titanate are significant for electronics research (2021, April 14) retrieved 3 May 2024 from <https://phys.org/news/2021-04-properties-strontium-titanate-significant-electronics.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.