

Dislocations as current channels in reduced strontium titanate

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Strontium titanate is an extensively-studied model material of perovskite oxides due to its exceptional electronic properties, which hold promising potential for applications in energy conversion and electronics. In these materials, the electronic transport properties are closely related to oxygen nonstoichiometry, which can be manipulated via redox reactions leading to a self-doping by oxygen vacancies [1]. Our nanoscale investigations on crystals and ceramics employing imaging techniques such as local-conductivity atomic force microscopy (LC-AFM) reveal that this reduction process is highly complex and heterogeneous on the nanoscale. Along extended defects such as dislocations there are easy reduction sites where oxygen vacancies are preferentially generated. In this way, filaments with high conductivity evolve around the dislocations in the originally insulating matrix and act as nanoscale short circuits [2]. Upon application of mechanical stress, these filaments can even be moved through the crystals along with the dislocations [3]. These findings not only can explain failure mechanisms in solid oxide electrolytes, but also raise fundamental questions regarding the mechanisms of electronic transport and superconductivity in self-doped transition metal oxides.

[1] C. Rodenbücher, C. Korte, T. Schmitz-Kempen, S. Bette, and K. Szot, *APL Mater.*, **9**, 011106 (2021).

[2] C. Rodenbücher, C. Guguschev, C. Korte, S. Bette, and K. Szot, *Crystals*, **11**, 744 (2021).

[3] C. Rodenbücher, G. Bihlmayer, C. Korte, and K. Szot, *APL Mater.*, **11**, 021108 (2023).