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Electric field induced pyroelectricity in strontium titanate

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Pyroelectric materials have a broad spectrum for practical application. Apart from the established infrared sensor technology, recently the pyroelectric effect has been employed unconventionally in waste heat recovery, X-ray generation or water disinfection. This coupling phenomenon is the temperature dependence of a ferroelectric's spontaneous polarisation. A crystal structure that allows pyroelectricity cannot have an inversion centre, if it had a polar axis would not exist. Hence the well-known perovskite strontium titanate, crystallizing in the space group Pm-3m, is known to be dielectric. Nonetheless, under an external electric field of 1MV/m charged defects like oxygen vacancies redistribute in a strontium titanate single crystal, leading to a distortion of the unit cell and sub-seq-uent-ly to the formation of a defect structure called the migration-induced field-stabilized polar (MFP) phase [1]. Raman scattering shows that the MFP phase of strontium titanate may ex-hibit broken centro-symmetry, suggesting the existence of a polar axis. Here, we investigate the pyroelectric properties of strontium titanate single crystals at room temp-era-ture during these electroformation cycles with a modified Sharp-Garn method [2]. Our frequency and field dependent measurements indicate the pyroelectricity of the MFP phase. Additionally the measurement method elucidates the kinetics of the oxygen vacancy migration as well as electric properties during electro-formation. Inducing pyroelectricity in a centro-symmetric crystal structure opens the scope for a new class of pyroelectric materials.

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