TRIGLYCINE SULPHATE DYNAMICS OF DOMAINS IN RELATION WITH TEMPERATURE AND BIAS FIELD

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Abstract. Triglycine sulphate crystal (TGS) is a hybrid organic-inorganic ferroelectric crystal with a large electronic band-gap, transparent in visible spectra. It has large applications in electronics, as thermal IR detector. Pure and doped TGS crystals of 3-5 cm linear dimensions were grown at constant temperature in the paraelectric phase (52 ^{o}C), by slow solvent evaporation. Pure TGS samples show non-reproducible values of permittivity and losses in the ferroelectric phase after the "excursion" in the paraelectric phase. Walking up and down the crystal temperature, using a special program, the permitivity and losses were automatically recorded and analyzed. There is a continuous decrease of permittivity towards an equilibrium value during a long period of time. Previous AFM measurements from the literature have revealed peculiar aspects of domain dynamics. The relaxation process of permittivity was considered according to the equation $\varepsilon_r = A - B \exp(-t/\tau)$. However, surprisingly, there is not a unique relaxation time τ. For the first 500 sec (or so), the relaxation time is $\tau \approx 7$ minutes, while between the next time decades 1.000 - 10.000 - 100.000 sec, it is approximately 1 hour and 8 h respectively. The process is related with the ferroelectric domain's dynamics, which are more or less strongly pined by dislocations or some other lattice defects.

Keywords: Perovskite; First-principles calculations; Electronic properties; Elastic properties

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1. Introduction

Triglycine sulphate crystal, TGS for short, with the chemical formula $(NH_2CH_2COOH)_3 H_2SO_4$ is a hybrid organic-inorganic material. It is a ferroelectric crystal which undergoes a typical second order ferroelectric transition around 49.2^{o}C. It has important applications in electronics devices, as IR detector, gas sensor, etc, having a great figure of merit versus other crystals or PZT ceramics [1]. Pyroelectric vidicon tubes use crystals of the TGS family as target materials [1,2]. Doped crystals have usually more stable ferroelectric parameters, lower dielectric constants and lower losses, i.e., higher figures of merit [3,4].

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