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DETERMINATION OF SMALL BIAS FIELDS IN TGS USING DIELECTRIC NONLINEARITIES

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Abstract Dielectric nonlinearities in triglycine sulfate (TGS) have been measured by the analysis of harmonic components of the electric current, while a sinusoidal electric field was applied to the sample. From the nonlinear permittivities of second and third order in the paraelectric phase small bias fields can be evaluated. In the TGS sample a bias field in the order of 100 V/m with a temperature dependence according to a constant polarization of 8.5 $\mu C/m^2$ was found. This result can be explained by fixed dipolar defects.

INTRODUCTION

Nonlinear dielectric permittivities of ferroelectric materials in the paraelectric phase provide information on the ferroelectric phase transition and on defects. From the nonlinear dielectric permittivities of odd order the Landau parameters are directly accessible, without any assumption concerning their temperature dependence. The even order permittivities vanish for a material with inversion symmetry, what is the case for a ferroelectric in the paraelectric phase. They are different from zero, if there are defects in the material that break the symmetry. The influence of these defects is also evident in the ferroelectric phase, where the hystereses curve if shifted on the electric field axis by the amount of the so called internal bias field.

THEORY

For a phenomenological description of the ferroelectric properties of a material by the Landau theory, the ferroelectric contribution to the free energy F is written as a polynom of the dielectric displacement D:

$$F = F_0 + \frac{1}{2}\alpha D^2 + \frac{1}{4}\gamma D^4 + \frac{1}{6}\delta D^6 \tag{1}$$

The Landau parameters α, γ and δ are temperature dependent in general. A measurement