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POLING OF P(VDF-TrFE) WITH FERROELECTRICALLY APPLIED DIELECTRIC DISPLACEMENT

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Abstract A new poling technique is presented, in which an unmetallized polymer film is poled in a sandwich between ferroelectric crystals. If a high electrical voltage is applied to the stack, the polarization of the ferroelectric crystals is saturated, and the interfaces to the polymer film form well defined sources for a high dielectric displacement. Destructive electrical breakdown is prevented. Therefore ferroelectric electrode poling (FEP) is in particular useful if poling fields near the breakdown field are required or even if the film contains imperfections. P(VDF-TrFE) films in the composition 70/30 mol-% have been poled between TGS and $BaTiO_3$ crystals. The polarization obtained shows a uniform profile over the film thickness. Poled between $BaTiO_3$, a high polarization and a high pyroelectric coefficient are achieved. These results show that charge injection from metal electrodes is not essential for the poling of P(VDF-TrFE) with a high dielectric displacement.

INTRODUCTION

Procedures for the preparation of a ferroelectric in a state with a high macroscopic polarization are important for both fundamental research and applications. For many experimental studies of ferroelectrics, the starting point is the preparation of a single domain state, which is not affected by domain wall contributions to the free energy. Applications make use of physical properties, which are directly related to the macroscopic polarization. Examples are pyroelectric sensors, piezoelectric sensors and actuators or electrooptical devices. For all of these applications it is desirable to polarize the material as highly as possible. Moreover, the spatial distribution of the polarization is important in many cases. Polarization distributions influence the response of pyroelectric ir-sensors[1], and the performance of measurement devices using the pyroelectric effect. Examples are pyroelectric microcalorimeters for specific heat[2] and thermal diffusivity measurements[3] as well as in photo pyroelectric spectroscopy techniques[4].

Polarization methods for ferroelectrics or for dipolar electrets are generally based on the application of an electrical field to the material. Although the poling process is conceptually simple, it can be quite complex in practice. For many polar materials, in particular for polar polymers, a problem is caused by the fact that the coercive field strength required for the orientation of the polar groups is only slightly