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THE FERROELECTRIC PHASE TRANSITION OF P(VDF-TrFE) POLYMERS

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Abstract A method is described, that enables the simultaneous measurement of the pyroelectric coefficient, the specific heat and the dielectric constant of thin pyroelectric films. Dielectric hysteresis loops and thermally stimulated depolarization currents are recorded to determine the spontaneous polarization. The method has been tested with TGS and is then applied to a 50/50 P(VDF-TrFE) polymer. The experimental results are explained with a simple model which takes into account that the ferroelectric crystallites are embedded in an amorphous matrix.

INTRODUCTION

Ferroelectric polymers are very interesting for pyroelectric applications in infrared detectors [1] and microcalorimeters [2]. The necessary condition for these applications is the detailed knowledge of the thermal, dielectric and pyroelectric properties.
In the present work a method is developed, which enables the measurement of the specific heat, the dielectric constant, the pyroelectric coefficient and the polarization.

SAMPLE PREPARATION AND EXPERIMENTAL ARRANGEMENTS

Sample preparation

For the sample a $25\mu m$ thick 50/50 P(VDF-TrFE) copolymerfilm from Solvay is used. On both sides of this film $50nm$ thick aluminium electrodes are evaporated in the form of a circle with $2mm$ in diameter touched by two stripes $200\mu m$ wide at opposite sides. With this arrangement it is possible to perform a precise measurement of the resistivity of the electrodes, which are used as bolometers. To increase the absorption of the electrodes, $18nm$ thick bismuth films are evaporated additionally. The sample is mounted in a temperature controlled cryostate.

Hysteresis measurement

For the measurement of dielectric hysteresis loops the Sawyer Tower arrangement [3] shown in Fig. 1 is used. The sample C_S is in series connection with a capacity C_M and an AC voltage source. If $C_M \gg C_S$, the voltage of the capacity C_M is proportional to the polarization of the sample. In the temperature range above $310K$ the conductivity of the polymerfilm is too large, so