

DIELECTRIC SPECTROSCOPY ON FERROELECTRIC P(VDF-TrFE)

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Abstract The complex dielectric function $\epsilon(f, T)$ of 70/30 P(VDF-TrFE) has been measured in the frequency range from $f = 10\text{MHz}$ to 10MHz and over the temperature range from $T = -50^\circ\text{C}$ to 130°C . The measured frequency spectra at each temperature are dominated by three relaxation processes. The characteristic relaxation frequencies increase with increasing temperature. The high frequent of the observed relaxation processes is associated with the ferroelectric properties of the material. Heating and cooling cycles showed a distinct thermal hysteresis of the dielectric function in the vicinity of the Curie temperature.

INTRODUCTION

The ferroelectric polymers PVDF and P(VDF-TrFE) of various compositions are interesting for a variety of applications, as examples one may list piezoelectric transducers, pyroelectric ir-sensors, hydrophones and microphones [1]. For all these applications it is important to know the dielectric function of the materials over a wide frequency and temperature range. Furthermore, the dielectric function $\epsilon(f, T)$ provide a wealth of information about the relaxation character of the polymer material [2]. Dielectric measurements on 70/30 P(VDF-TrFE) are reported by Legrand [3] for a measurement frequency of 1 kHz and by Petzelt et al. [4] in the submillimeter and FIR range. Furukawa and Johnson [5] report on measurements on 55/45 P(VDF-TrFE) over a frequency range from 50 Hz to $5 \cdot 10^7$ Hz over a wide temperature range. In the following we report on measurements of the complex dielectric function over a wide frequency and temperature range for a $10\mu\text{m}$ thick 70/30 P(VDF-TrFE) sample, prepared by spin-coating.

SAMPLE PREPARATION

Granules of the composition 70/30 P(VDF-TrFE) from ATOCHEM, France were dissolved in dimethylformamide. $10\mu\text{m}$ thick films were prepared by spin coating and dried at $50\text{-}60^\circ\text{C}$ for two hours, to remove the solvent. After the evaporation of silver electrodes the samples are baked at 130°C for five hours. The latter heat treatment is necessary to obtain reproducible results upon heating and cooling cycles.

EXPERIMENTAL ARRANGEMENT