POLARIZATION PROFILING OF THE SURFACE REGION OF PVDF AND P(VDF-TrFE)

Bernd PLOSS and Oliver BIANZANO

Institut für angewandte Physik, Universität Karlsruhe, Kaiserstraße 12,
D-76128 Karlsruhe, Germany

Abstract

Inhomogeneous polarization profiles are a typical property of ferroelectric polymers. Particularly in the surface region, the occurence of a nonpolar layer is often observed. Different mechanisms can cause the decrease of the polarization near the surface. The first is the injection of charge from the metal contacts into the polymer during the poling when high electric fields are applied to the sample. The second is a structural variation of the sample near the surface e. g., a lower degree of crystallinity than in the bulk. The LIMM method i. e., a scan of the polarization profile with thermal waves, is particularly appropriate for a investigation of the surface near region of a sample. The resolution of LIMM has been improved to be better than 100 nm by an increase of the modulation frequencies into the MHz region. With this increased resolution, the surface near polarization in samples of polyvinylidenefluoride and its copolymers with trifluorethylene has been investigated.

1. Introduction

For the measurement of charge and polarization distributions, various experimental techniques are available, which are based either on the piezoelectric or on the pyroelectric effect. Among the piezoelectric techniques, the pressure pulse [1,2] and the pressure step method [3] may be noted. The methods, which are based on the pyroelectric effect, are implemented in the time or in the frequency domain. Realized in the time domain is the thermal pulse method [4], while the Laser Intensity Modulation Method (LIMM) [5] uses thermal waves in the frequency domain. The time scale for the propagation of heat is much longer than for the propagation of a pressure wave. Therefore, thermal methods are favourable to achieve a high resolution near the sample surface. With LIMM, a resolution of about 0.5 μm had been reached [6].

In this paper we report on a resolution increase to better than 100 nm. Theoretical and experimental details of LIMM, which become essential in the modulation frequency range above 100 kHz are discussed. Results of surface near polarization investigations in samples of polyvinylidenefluoride (PVDF) and its copolymer with trifluorethylene (P(VDF-TrFE)) are presented.

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