RESONANCE CHARACTERISTICS AND POLARIZATION PROFILE OF PARTIALLY POLED P(VDF-TrFE) COPOLYMER

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Abstract

Thick films of polyvinylidene fluoride/trifluoroethylene (P(VDF-TrFE)) copolymer with the composition 80/20 mol-% were poled at elevated temperature. The dielectric spectrum of this film shows two resonance peaks which correspond to the fundamental and second harmonic of the thickness vibration mode. Even harmonics of the thickness mode are usually not observed as they are not coupled to the electrical excitation. Piezoelectric and pyroelectric profiling experiments using both the pressure wave propagation (PWP) method and the laser intensity modulation method (LIMM) show that the copolymer has an inhomogeneous polarization profile which leads to the observed second order harmonic. In particular, these methods indicate that an unpoled region exists near the cathode side of the sample. By fitting the observed dielectric spectrum to a model of two Lorentz oscillators, the oscillation strengths have been estimated and found to be consistent with those obtained from the appropriate Fourier coefficients of the measured pyroelectric profile.

1. Introduction

Because of their reasonably high electromechanical coupling factors and acoustic impedance appropriate for efficient acoustic coupling to water, vinylidene fluoride/trifluoroethylene copolymers are promising materials for transducer applications. For efficient excitation of thickness vibrations in the MHz range, films with thicknesses in the millimeter range are required. The recent observation that films prepared under particular poling conditions show a resonance at the second harmonic of the thickness vibration [1] provides the motivation to study the relation between the resonance characteristics and the polarization profile.

2. Sample preparation and poling

The starting material for the samples was 800 μm thick extruded vinylidene fluoride/trifluoroethylene copolymer in the composition 80/20 mol-% supplied by Atochem North America Inc.. Appropriately poled copolymer of this VDF content was reported