Integrated Ferroelectrics, 2002, Vol. 47, pp. 19–28
Reprints available directly from the publisher
Photocopying permitted by license only

DOI: 10.1080/10584580190044489

POLING OF FERROELECTRIC PT/P(VDF-TrFE) 0-3 COMPOSITE

Y.T. OR, B. PLOSS, F.G. SHIN, H.L.W. CHAN AND C.L. CHOY

Department of Applied Physics and Materials Research Centre, The Hong Kong Polytechnic University, Hong Kong, China

(Received in final form October 15, 2002)

Thick-film composites with 5 % to 30 % volume fraction of nanocrystalline lead titanate (PT) ceramic particles dispersed in a 70/30 mol-% vinylidene fluoride-trifluoroethylene [P(VDF-TrFE)] copolymer matrix were prepared by solution casting followed by compression moulding. The crystal structure of the PT particles and the microstructure of the composite were characterized by XRD and SEM, respectively. The composites were poled at elevated temperature to produce samples with only the ceramic phase polarized. The poling current was recorded during the poling process, and a roughly exponential decay has been observed with "time constants" in the order of 10^3 s. The pyroelectric coefficient has been studied as a function of poling time. The built-up of the pyroelectric coefficient is faster than the decay of the poling current. Among composites with different ceramic loading the polarization develops with a higher rate in the composites with higher ceramic volume fraction. The polarization profiles of the poled composites have also been studied using the laser intensity modulation method (LIMM). Composite films with 30 % ceramic volume fraction poled for 10^3 s show a uniform polarization profile along the thickness direction, except in regions very close to the surfaces. The poling state of the ceramic inclusions was investigated by XRD. Intensity changes in the (002) and (200) diffraction peaks after poling reflect 90° domain switching in the PT inclusions. The poling ratio was estimated from the intensities of the diffraction peaks. A higher poling ratio of the ceramic inclusions was obtained in composites with higher ceramic volume fraction.

Keywords: lead titanate, 0-3 composite, polarization, pyroelectric, LIMM

1. INTRODUCTION

Ferroelectric composites have a promising potential for applications as they combine the high pyroelectric and piezoelectric coefficient of the ceramic with good mechanical properties of the polymer. The selection of the components and of the volume ratio allows the fabrication of new materials with custom tailored properties. In order to induce piezoelectric and pyroelectric activities, the materials must be subjected to a poling process to induce a spontaneous polarization in the