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Pyroelectric Properties of Ferroelectric 0–3 Composites Near Matrix Transition Temperature

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The pyroelectric properties of a ferroelectric 0–3 composite in the vicinity of the matrix Curie temperature is examined theoretically by incorporating the effects of interfacial charge. A dip predicted in the pyroelectric coefficient as a function of temperature of the composite is associated with the contribution of the secondary pyroelectric effect and/or with incomplete charge compensation of the polarization heterogeneity. At the Curie point of the matrix, the magnitude of the secondary pyroelectric coefficient may be relatively large and cannot be neglected.

Keywords 0–3 Composites; interfacial charges; pyroelectric

I. Introduction

Many studies show that the interaction of charges and polar crystallites/polarization play an important role in the pyroelectric response of ferroelectric polymers [1] and ferroelectric composites [2, 3]. The role of charges residing at interfaces has been evidenced to stabilize the polarization of the crystalline phase in ferroelectric polymers and contribute to the pyroelectric effect. In composites, the interfacial charges could lead to the occurrence of internal electric fields that affect the pyroelectric response of the materials.

Ploss et al. [2] study the internal field in the matrix by looking at the temperature dependence of pyroelectric response of a lead titanate/PVDF-TrFE 0–3 composite, with only the ceramic polarized, in both theory and experiment. A dip is found in the pyroelectric coefficient of the composite near the transition temperature of the matrix due to incomplete charge compensation at the matrix-inclusion interfaces. Their theoretical study indicates that the existence of the dip is associated with the interplay between the interfacial charges and the strong temperature dependence of the permittivity of the matrix at the transition temperature. In the model, however, only the primary pyroelectric effect is considered. At the region near the transition point of the matrix, high values of electrothermal-mechanical

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