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Improving the Pyroelectric Coefficient of Ceramic/Polymer Composite by Doping the Polymer Matrix

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To obtain an optimum coupling of the pyroelectric activity of ferroelectric inclusions to the electrodes of a 0–3 composite film, the dielectric constants of matrix material and inclusions would have to be comparable. While there is no way to substantially raise the real part of the dielectric constant of the polymer matrix, the imaginary part can be increased by an appropriate doping. The results from theoretical modelling predict a significant increase of the pyroelectric coefficient and especially the pyroelectric signal power. Experimental investigations on composites of lead titanate particles in polyurethane doped with potassium bromide show the improvement and give hints to further optimization of its pyroelectric performance.

Keywords Pyroelectric materials; composites; conducting polymers; ceramic particles

Introduction

Composites of ferroelectric ceramic particles in a polymer matrix are extensively studied as materials for pyroelectric sensors [1], in particular because of their process compatibility with the fabrication of integrated circuits. The performance of these pyroelectric composites is, however, limited by the dielectric mismatch between the high dielectric permittivity of the ferroelectric ceramic particles and the substantially lower dielectric permittivity of the polymer matrix.

Theory

We assume a 0–3 composite of pyroelectric ceramic particles dispersed in an unpolar matrix material as illustrated in Fig. 1. The ceramic particles are assumed to have the pyroelectric coefficient p_i and the relative dielectric permittivity ε_i. Assuming that the relative dielectric permittivity ε_m of the matrix material could be chosen arbitrarily, we are discussing in the following consideration, which value of ε_m would be optimum.

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