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Pyroelectric Ceramic/Polymer Composite with Electrically Conducting Matrix Material

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To improve the coupling of the pyroelectric activity of the ferroelectric particles to the electrodes of a composite film we propose the use of a matrix material which is not a perfect insulator but shows some electric conduction. Theoretical modelling results show that the pyroelectric coefficient of these composites is drastically enhanced. Furthermore, the noise figure of merit can be optimized by a proper selection of the electric conductivity of the polymer matrix. For the practical application in a sensor, these new composites have the additional advantage that the gate voltage of the first field effect transistor can be supplied through the resistance of the pyroelectric sensor element.

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, 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.

Pyroelectric Composites

For spherical inclusions of low volume fraction v the pyroelectric coefficient p and the dielectric permittivity ε of a composite can be approximated by using the Maxwell-Wagner model [1]:

$$p = v\frac{3\varepsilon_m}{(2+v)\varepsilon_m + (1-v)\varepsilon_i}\,p_i \tag{1}$$

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