Thermal-Pulse Tomography of Space-Charge and Polarization Distributions in Electret Polymers

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The non-destructive detection of polarization and space-charge distributions via thermal methods is a key technique in electret research and the development of novel transducer materials. In the most widely used form, a thermal pulse or wave is created through the absorption of laser light by an opaque front electrode. The resulting pyroelectric or displacement current carries information on the spatial distribution of embedded electric dipoles or space charges in the direction normal to the surface. Taking advantage of modern numerical data processing techniques, we implemented a scanning thermal-pulse microscope capable of recording tomographic polarization images with a near-surface depth resolution of less than 0.5 µm and an in-plane resolution of 38 µm, the latter being limited by fast lateral heat diffusion in the top electrode material. Extracting the spatial polarization distribution from the short-circuit current is an ill-posed problem and was performed in the frequency domain after Fourier-transforming the transient thermal-pulse signal. The presentation will give an overview over possible applications, outline the data analysis procedure, and discuss potential resolution and sensitivity limitations.