Measurement of Space Charge in Polymer Dielectric Films by PEA Method

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Abstract

The space charge density in polyimide film was measured using the PEA method. The charge density at the interface of the electrode and the sample increased as the negative d.c. bias voltage was increased. As the applied voltage became large, the charge density increased after the voltage was brought up to zero. During the d.c. bias voltage application, the charge density decreased at interfaces of the upper and lower electrodes, but the bottoms of the peaks broadened. The homogeneous space charge was formed in the sample due to the charge injection. When the voltage was brought up to zero, space charge density decreased as time elapsed, and the space charge in the sample interior gradually diffused out of the sample.

During the application of the positive or negative d.c. bias voltage, the form and size of the space charge density did not change. When the positive bias voltage was applied, it was found that the negative space charge density near the lower electrode became greater and electrons were injected easily.

Keywords: Space charge, Pulsed-electroacoustic method, polyimide

1. Introduction

Polyimide film has no softening point below a temperature of 500°C and it has excellent mechanical characteristics in the range from the temperature of liquid helium to 500°C. It is thus considered one of the best heat-resistant macro-molecules[1]. It is also highly resistant to radioactivity, such as beta and gamma rays, as well as to chemicals. Thus it is expected that polyimide film will be adopted as an electrical insulating material for use in severe environments. There have been many reports on the dielectric, electroconductive and dielectric breakdown characteristics of polyimide[2-6]. However, there has been little consideration of space charge, which may have an adverse effect on electrical insulating property.

This study investigated the changes over time in space charge density and its distribution after a bias voltage was applied to polyimide films.

2. Specimens and experimental method

2.1 Specimens

We used 50 mm×50 mm specimens of polyimide film (Kapton H, thickness of 125 μm) made

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