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Effect of 1-chloro-2,3-epoxy-propane on the conduction mechanism in polyvinyl chloride

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Abstract

The nature of the electrical conduction in polyvinyl chloride (PVC) containing 1-chloro-2,3-epoxy-propane has been studied at a constant temperature of 297 K. In the first region of the *I–V* characteristics (slope ≈ 1), the conduction is Ohmic because there is no injection of carriers from the electrode contact. The Richardson–Schottky effect is the predominant conduction mechanism in the second region (slope ≈ 2). The variation of dc conductivity, σ, may be due to the combined effect of change in σ with temperature, and the nature of trap distribution in the sample. At higher temperatures, the increase in σ may be due to the sample softening.

1. Introduction

The current injection in polymers containing various trap configurations is well known for a long time [1]. The presence of trapping sites in the forbidden gap of an insulator strongly affects the current–voltage characteristics of the polymer. The magnitude of the current that flows is very much reduced due to the trapping effect. The *I–V* characteristics depend on the type of trap distribution [2]. Chand et al. [3,4] studied the effect of iodine on the electrical conduction in polyvinyl fluoride (PVF) and polycarbonate films. The average values of drift mobility and trapped carrier density calculated from the *I–V* characteristics have been found to be strongly affected by the presence of iodine. The activation energy is also affected by iodine concentration.

On the other hand, the nature of possible conduction mechanisms in polymers containing organic compounds has not yet been fully understood, probably because of their highly disordered structure. Thus we have made an attempt to understand the nature of the conduction mechanisms in PVC containing 1-chloro-2,3-epoxy-propane by studying its electrical properties.

2. Experimental

Polyvinyl chloride (PVC) (Nippon Zeon Co. Ltd) was used. 1-chloro-2,3-epoxy-propane was added to a solution of the polymer in tetrahydrofuran (THF, Aldrich). Polymer films were obtained by evaporation of the solvent in vacuo. The PVC samples containing no additives were treated under the same conditions. The additive concentration in the polymer was ranging from 5 up to 30 wt%.

Samples were cut in the form of discs of 25 mm^2 area and 0.1 mm thickness. The samples were painted with silver paste as electrodes. A temperature-con-

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