

Thermal depolarisation current study of electron irradiated fluorinated ethylene propylene

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Abstract. Thermally stimulated current (TSC) studies have been reported in the co-polymer of tetrafluoro ethylene and hexafluoropropylene films. Depolarisation current peaks are obtained at α_1 , α_2 and β relaxation temperatures of the polymer and the detrapping process is explained on the basis of its molecular motion. A cross-over electron energy of 18 keV is observed where the nature of TSC spectra undergoes a remarkable change. This is explained in relation to the surface states in FEP. Five groups of trapping levels, 0.25 ± 0.08 , 0.57 ± 0.10 , 1.07 ± 0.1 , 1.3 ± 0.25 and 2.3 ± 0.4 eV are obtained.

Keywords. Depolarisation; trapping; molecular motion; surface states; fluorinated ethylene propylene; thermally stimulated current.

1. Introduction

Despite the fact that the thermally stimulated current (TSC) measurements in fluorinated ethylene propylene (FEP) have been widely studied using various methods (Sessler and West 1962, 1968; Perlman and Reedyk 1968; Murphy and Fraim 1968; Tyler *et al* 1955; Reiser *et al* 1969; Seiwatz and Brophy 1965) for charging, little of information is available on the charge release process and its relation to the molecular motions of polymer. An attempt is therefore made to understand the charge release process in FEP. The low energy electron bombardment with non-penetrating (range of electrons less than the foil thickness) beam of electrons is used for charging the FEP foils. From the experimental results a correlation has been found between the charging of the films and the surface states in the polymer. Earlier studies on electron bombarded teflon FEP (Turnhout 1975) shows that there are at least two possible traps for the charges in this polymer and the thermal release of charges from these traps is related to the molecular motion in the host polymer. By analysing our experimental results, it is found that trapped charges in this polymer are released at least at three different temperatures, characteristic of its molecular motions and there are at least five trapping levels for low energy electron irradiated samples.

This paper reports the results of short circuit TSC of 250 μm teflon FEP after open circuit irradiation with electrons ranging between 3-30 keV. Two well-defined peaks are obtained near glass transition temperature for the foils irradiated below an energy of 18 keV electrons. A change in the nature of spectra has been observed at and above the electron energy of 18 keV. This has been explained in terms of the range of incident electrons and the surface states in the polymer.