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STUDY OF CHARGING, DISCHARGING AND MECHANICAL PROPERTIES OF PURE AND MALACHITE GREEN DOPED PVK SAMPLES

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ABSTRACT
Charging, discharging and mechanical properties of pure and malachite green doped PVK samples have been studied. The Transient current studies have been carried out by patterns of electrets formed by polarization method in the range of 400 volts field strengths at 40◦C to 70◦C with constant heating rates. The results obtained show the shift of the TSD peak position towards lower temperature ranges. Decrease in activation energy was observed corresponding to the increase in polarizing field. The intensity of the peak maxima results in being a good indicator of the trapped carrier number evolution. For high temperatures and high electrical fields the saturation of the phenomenon is achieved faster, which is attributed to facilitated carrier mobility. The formation of charge transfer complexes is evidenced in the polymer matrix.

KeyWords: TSDC, FTIR, UV, activation energy

INTRODUCTION

Over the years, the involvement of polymers in electrical applications has been due to their electrical insulation properties. Polymers acquire persistent polarization due to the alignment of dipoles and migration of charge carriers over macroscopic distances. The electrical transport in polymeric materials [1-5] has become an increasingly interesting area of research, partly because these materials possess great potential for solid state devices and partly because this field of study serves as a stepping stone towards the understanding of the general theory of polymer physics [6]. Transient current studies help in a better understanding of the electret formation and relaxation mechanisms.

Experimental

The measurements of charging and discharging currents were carried out on samples charged with fields of 400 volts and at charging temperatures 40, 50, 60, and 70°C. Samples have been investigated over a time period of 1-100 minutes. For each measurement, a fresh sample was taken. The sample was sandwiched between the two plane parallel metallic electrodes of the measuring cell based on the three terminal method as shown in the schematic diagram [Figure 1]. A typical charge-discharge current cycle for a polymer is shown in Figure 2.

The sample is sandwiched between the plates of the capacitor, made of aluminum, and a high dc voltage is applied across the two electrodes of the assembly by using a power supply (Scientific Equipments, Roorkee, EHT-11).

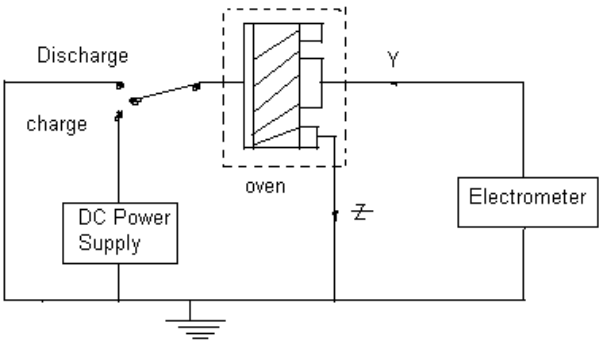

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Figure 1:Schematic diagram of measuring system for the DC transient current experiment.

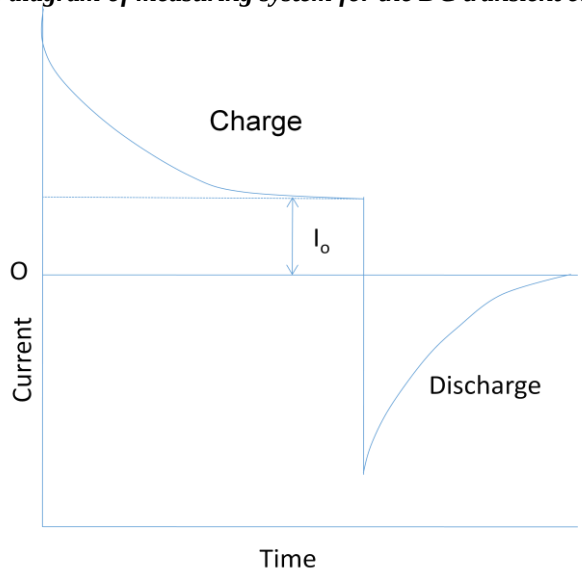

Figure 2:Typical charging – discharging cycle.

RESULTS AND DISSCUSSION

The result of transient currents in charging and discharging modes are analyzed and interpreted on the basis of existing theories.

The time dependence of the charging and discharging transient currents in polyvinyl carbozole and malachite green doped PVK samples have been investigated over a time period of 1-100 minutes. The Figures 3 -4 show the variation of charging and discharging transient currents with time at different temperatures, i.e. 40, 50, 60 and 70^{o}C with polarizing fields of 400 for pure and malachite green doped PVK samples.

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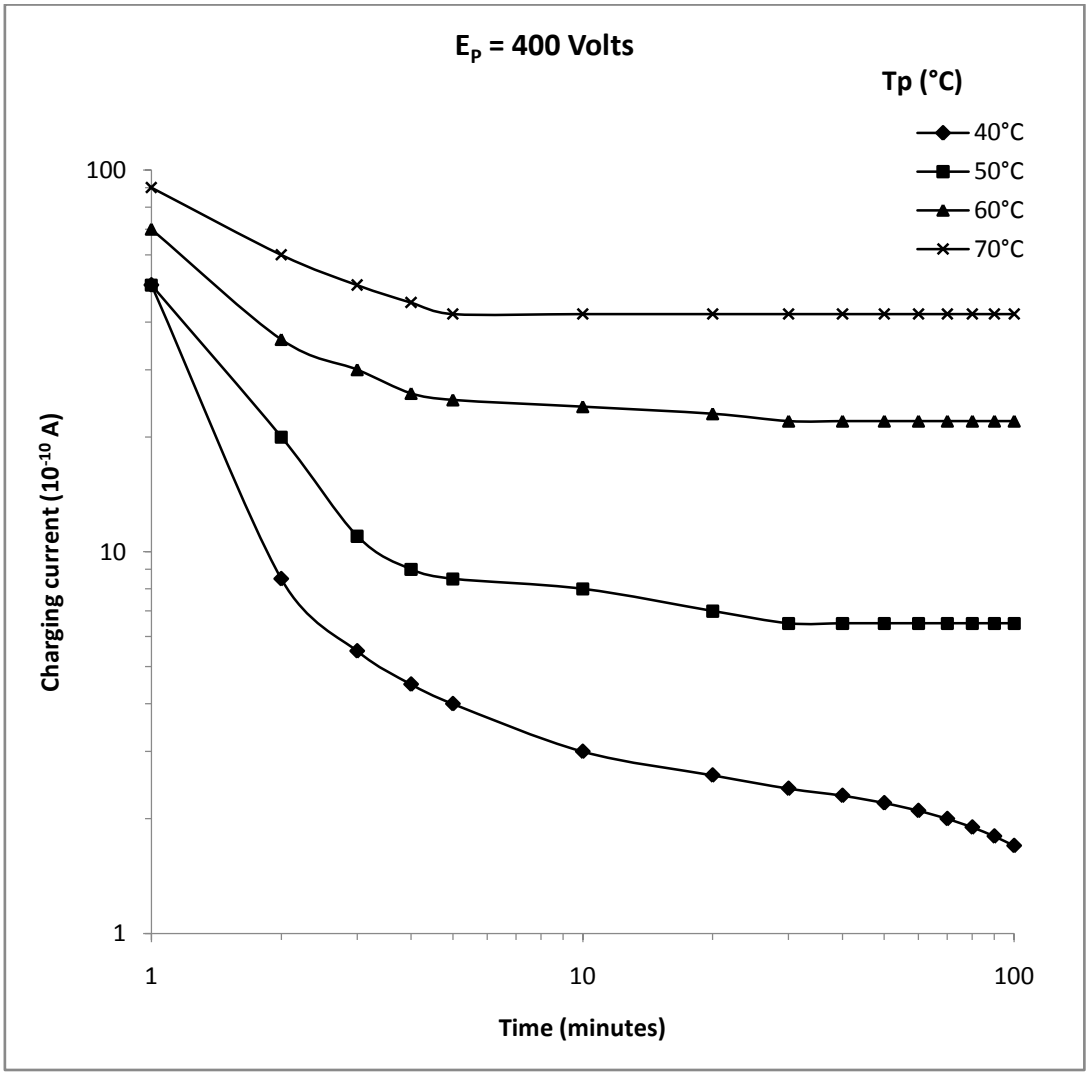

Figure 3:Current transient versus time curves at various temperatures for pure PVK films with 400 volts.

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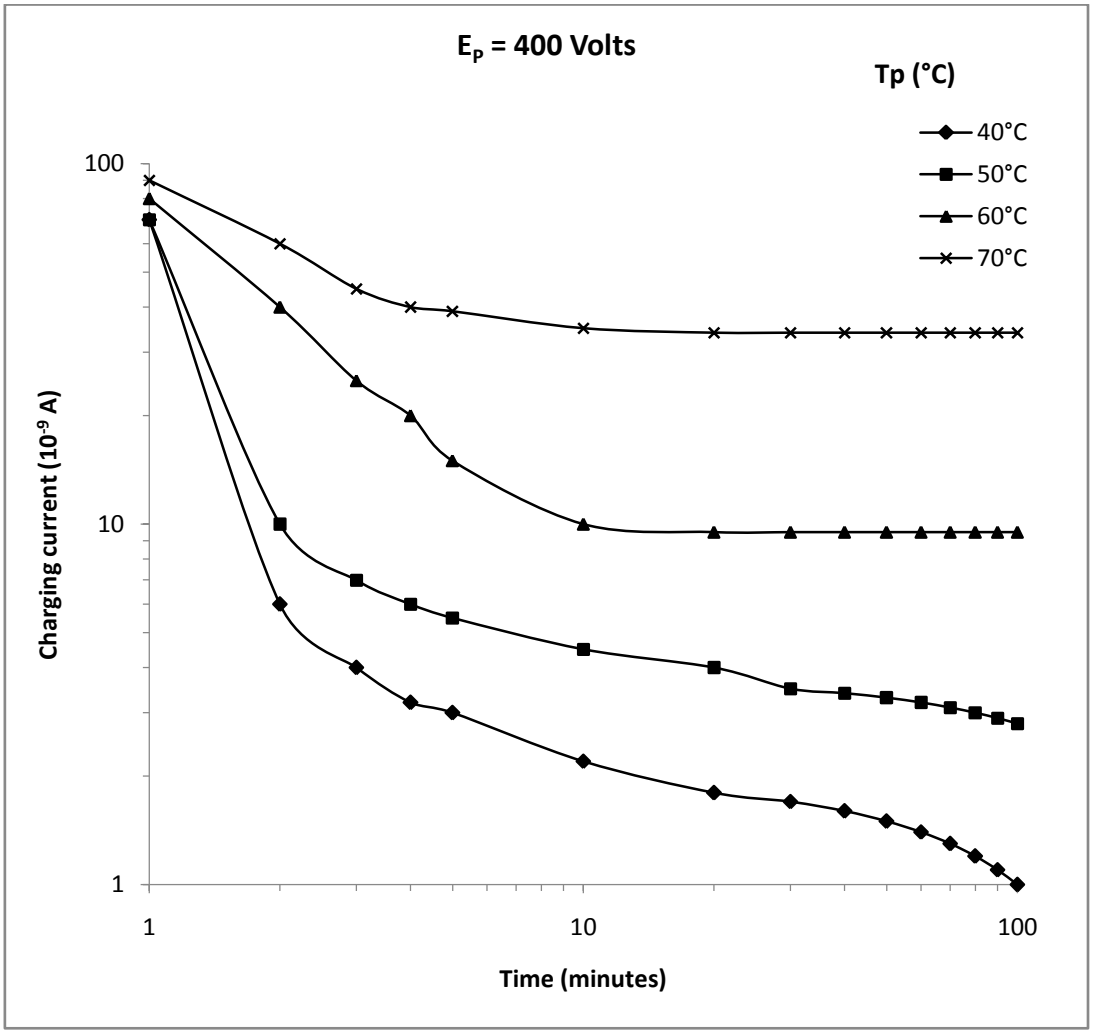

Figure 4: Current transient versus time curves at various temperatures for malachite green doped PVK films with 400 volts.

It is evident from the figures that the current decays at a faster rate for a few minutes and then the decay rate slows down[7-12]. Time dependence of transient charging and discharging currents are, in general characterized with two regions which are designated as the short- time and the long time regions, respectively. From the above characteristics, it is clear that at least two distinct mechanisms should be responsible for the observed transient currents.

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