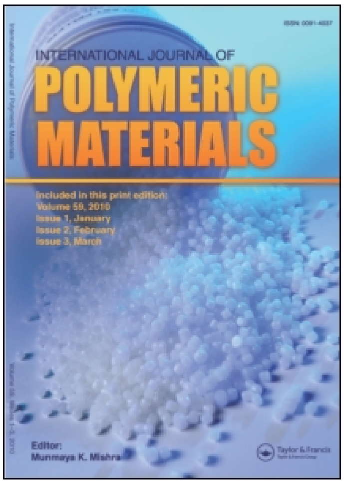

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Influence of Magnetic Field on the Resistivity of Polyisoxazoline

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The effect of magnetic field on the electrical resistivity of polyisoxazoline was studied in the temperature range 300–413 K. It is noticed that the resistivity was reduced by the application of a magnetic field with 1000 Oe.

Keywords: Polyisoxazoline; magnetic field; resistivity

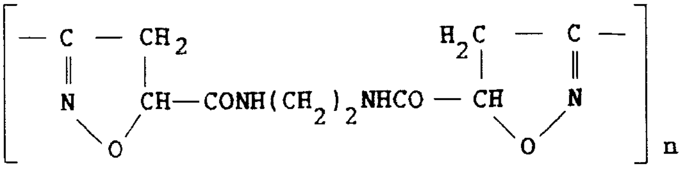
INTRODUCTION

It is well known that the study of conduction mechanisms in organic conjugated polymers leads to the development of a new class of electronic materials [1]. While the interest in semiconducting polymers has been constantly increase. Investigations concerned with semiconducting polymers with heterocyclic rings in the polymer chain such as polybenzimidazole [2] and polypyrole [3] had attract attention in the present time.

The influence of static magnetic field on the various properties of polymers has been investigated [4, 5]. Here we try to study the effect of a static magnetic field on the resistivity behavior of polisoxazoline.

EXPERIMENTAL

Polyisoxazoline was synthesized from the reaction of terephthalohydroxamoyl chloride with corresponding dipolarophiles in refluxing



toluene and was purified by extracting in hot methanol. Polyisoxazoline has the chemical structure was compressed to form discs with 1mm thickness and 5mm diameter. The discs were kept for 30 min under a given temperature and electric voltage. The resistivity was measured under the influence of static magnetic field with 1000 Oe with the using of a Keithely 614 electrometer.

RESULTS AND DISCUSSION

The electrical resistivity of polyisoxazoline was measured at various temperatures ranged from 300–413 K. It is noticed that the resistivity

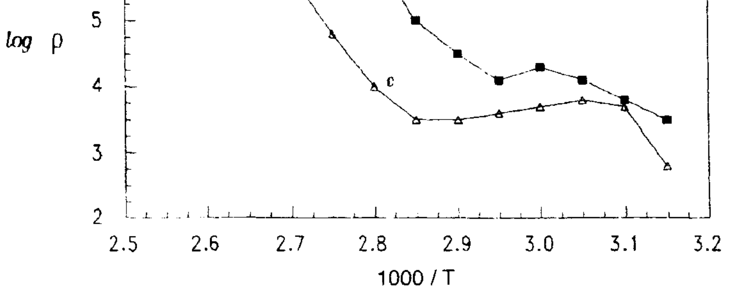


FIGURE 1 Variation of resistivity vs 1/T for polyisoxazoline under the effect of static magnetic field of 1000 Oe. (a) without field; (b) with field parallel to the sample and (c) with magnetic field perpendicular to the sample.

data obeys the usual exponential equation for semiconductive behavior

$$\rho = \rho_o \exp E_g / 2\,\mathrm{k}\,T$$

where ρ is the resistivity (Ωcm), E_g the energy gap for the conduction (eV), k Boltzmann's const and T the absolute temperature. The calculated energy gap was found to be 1.107 eV.

The effect of the static magnetic field was determined not only by the chemical structure but also by the chain mobility, i.e., by the relaxation type of the polymer [6]. Consequently, such important factors as the temperature and the duration of the application of the static magnetic field are important. Since the magnetic field oriented the molecules, it would be logical to expect the action of the field and the effects of direction (parallel or perpendicular) to be the same as the effects of the electric field.

The orientation effect of the magnetic field on the polymer observed even in the glassy state. Therefore, a sufficiently long exposure to static magnetic field had a significant influence on the resistivity of the polymer in the glassy state. The reaction of the same field could be different at different temperatures corresponding to different processes [3]. According to the fact that the absorption of the electromagnetic energy depends on the magnetic field. It is observed that, the resistivity of the polymer is lowered with the application of the field. This effect is stronger when the field is parallel (i.e. the vector B lies in the polymer sample) than in the perpendicular case (i.e. when **B** is perpendicular to the sample).

To interpret this behavior one may suggested that, in the perpendicular case the magnetic field will be able to rotate both the —NHCO— bond and the aliphatic unit (in the main chain) by a greater angle. But in the parallel case the rotation is slightly small. From another point of view, in a magnetic field a moving electric charge is subject to the Lorentz force, which results in twisting of the paths and consequently, reduces their resistivity.

The expected reaction of the polymer and the magnetic field in the studied temperature range was of relaxation nature and was probably related to the motion of small sections of chains. Comparable with the size of a segment, because in this temperature range the relaxation was observed [7]. Since the high mobility of the molecules at $T > T_g$ was due to short relaxations of longer kinetic units [8]. Thus, orientations occurring in the magnetic field may be due to longer kinetic units.

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