

The Thermally Stimulated Current (TSC), a Spectroscopy Technique for Exploration of the Materials Structure

Christine MAYOUX

SETARAM, 7 rue de l'Oratoire, 69300 Caluire, FRANCE

At the origin, this technique has been established in the seventies and recently, it is based on the ability of polar molecules to be moved by an electric static field, the principle is the following: at a temperature T_p , we applied the field during a time t_p long enough to let the dipoles to orient themselves and we fix this configuration by a rapidly decrease in temperature to reach a temperature T_0 . At this temperature, the sample is short-circuited during a time t_0 to remove the space charges and to equilibrate the temperature. The progressive and sequential release of the entities oriented previously can be observed during a linear rise in temperature. The depolarization current is then recorded as a function of the temperature: this is the complex spectrum. This latter could be decompose in a series of elementary spectra by using the Fractional Polarization Technique (1) allowing us to describe each dielectric manifestation in terms of relaxation times and dynamics parameters (ΔH , ΔS). It consists in applying the polarization within a sufficiently narrow temperature range to permit the selective orientation of dipolar entities characterized by a single relaxation time. The TSC peak thus recorded is "elementary", i.e. it obeys Debye's law. The movement of the range along the temperature axis permits identifying the elementary components of the complex relaxation spectrum, which is then resolved in a discrete distribution function. The temperature dependence of the elementary relaxation times is obtained, without prior hypothesis, thereby permitting identification of the molecular source of the process observed.

Several examples exist in different domains, pharmaceutical, food, coatings or gel (2).....to demonstrate that data obtained thanks to this technique have allowed a better understanding, for example, of the behavior of a material under the influence of temperature, oxidation, plasticization, crystallization or to explore the chemical organization of complex structures.

Reference:

- 1- G.Teysse, M. Grimau, A. Bernes, JJ. Martinez, C. Lacabanne, *Polymer*, 1994, Vol 35,4397-4403.
- 2- C.Mayoux,J.Dandurand,A.Ricard, C. Lacabanne, *Journal of Applied Polymer*, 2000, 77, 2621-2630.