Thermally Stimulated Current (TSC) spectroscopy and structure of material

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TSC 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 allowing us to describe each dielectric manifestation in terms of relaxation times and dynamics parameters (ÄH, ÄS). 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 in different domains, pharmaceutical, food, coatings or biopolymers[1] could be taken 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.

1- "Comparison of chemical treatments on the chain dynamic and thermal stability of bovine pericardium collagen."V. Samouillan,[1] J. Dandurand,[1] C. Lacabanne,[1] R. J. Thoma,[2] A. Adams,[2] M. Moore[2].
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