Effect of Water Vapour on Thermoelectret Behaviour (*).

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Summary. — A detailed study has been made of the shellac wax and polyvinyl chloride (SR11) thermoelectret under different humidity conditions, ranging from 40% to 97% R.H. After the polarization of the samples, the surface charges have been measured with the induction method and the depolarization current by the thermally stimulated discharge current technique (TSD). It has been found that surface charges become zero if the samples are kept in more than 85% R.H. atmosphere for a short duration. The relaxation time decreases with the increase in exposure time to the humid atmosphere. Activation energy is also calculated from the glow peak analysis.

1. - Introduction.

Investigations of the mechanism of electret formation in dielectric materials have given an insight into the dipolar, electronic and ionic processes in solids. Persistent polarization is generally obtained when a dielectric material is melted and solidified under the influence of a high electric field. An extensive study of this has already been made in carnauba wax and other wax mixtures by Eguchi (1), Gemant (2) and Gross (3). But not much work has yet been reported on plastic materials which have a more stable surface charge retention

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(2) A. GEMANT: Phil. Mag., 20, 929 (1935).

properties than wax electrets even in humid surroundings. Although the behaviour of the electret is now fairly well known, no generally accepted theory of its physical mechanism has been established so far. From a practical point of view, a systematic study is also required to see the effect of humidity on the charge decay characteristics of electrets.

Surface charge decay characteristics of the electrets prepared from the shellac wax and polyvinyl chloride (SR11) under different conditions of humidity are reported in this paper. It has been reported (4) that permanent polarization in electrets is due to the orientation of dipoles, no direct observation in this respect has been recorded so far. The recently developed «thermally stimulated discharge current» (TSD) technique has been employed by Perlman (9) and Turnhout (7) to analyze the charge formation characteristics of electrets in a semi-quantitative manner. The above technique is used in the present investigation to understand the effect of humidity on shellac wax electrets.

2. - Theory.

Bucci et al. (8) put forward a theory of ionic thermal current for alkali halide crystals, which has recently been used by Gross (9), Perlman (10) and Turnhout (11) for the electret effect.

As the decay of charge proceeds slowly at room temperature, it is advisable to stimulate the discharge by heating at a linear rate. The discharge current $i$ is simply the rate of change of polarization

$$i = \frac{P_0}{\tau} \exp \left[ \frac{-t}{\tau} \right],$$

where $\tau$ is the relaxation time and the product $P_0 = i_0 \tau$ corresponds to the initially stored charge.

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(4) A. Gement: Direct Current, 1, 145 (1953).