Another feature of importance is that θ_0 is proportional to $\sqrt{(P/f)}$, whereas in the instrument described previously[1] the deflexion is proportional to P/f. It follows that the new method has the advantage that the deflexion falls off less rapidly with decreasing power and increasing frequency. However, the formula quoted above is only valid when the angular rotation of the dipole required to detune the cavity to $1/\sqrt{2}$ of the amplitude at resonance is small in comparison with θ_0. If this condition is not met, a correction including the Q-factor must be introduced.

Preliminary experiments at a wave-length of 3·2 cm. show that an adequate deflexion ($\sim$ 30 cm. at 1 metre) can be obtained easily with a power of 100 mW. or less.

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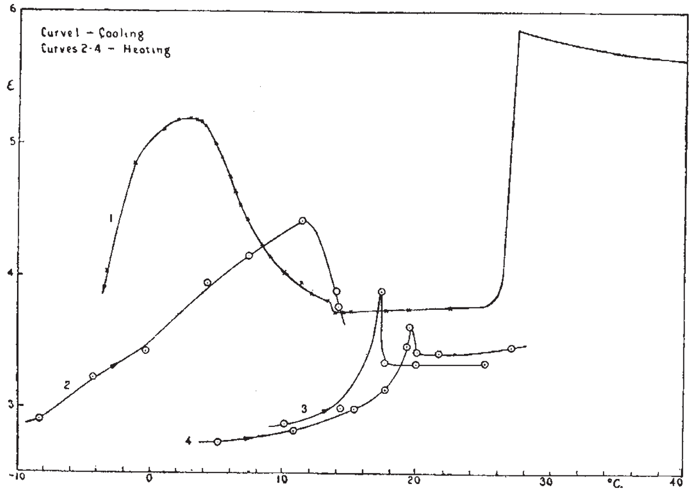
[1] Cullen, A. L., and Stephenson, I. M., I.E.E. Monograph No. 42.

Dielectric Observations of Nucleation

CERTAIN long-chain ketones of equal chain-lengths but different position of the keto group have such similar properties as to be reminiscent of isotopes and are yet nearly mutually immiscible in the solid state. Mixtures of equal amounts of a sufficient number of such 'equivalent' ketones are, however, stable either as a single-phase solid solution or as a multiphase mixture of the constituents[1]. Mixtures of this kind are exceptionally suitable for a study of precipitation, since all constituents are precipitated simultaneously. Recent measurements of dielectric properties carried out during the precipitation of such a mixture yield information on early stages of nucleation and on the dielectric properties of small aggregates.



Dielectric constant of a mixture of five ketones in the course of precipitation

The mixture investigated consisted of equal amounts of five equivalent ketones of the formula $C_mH_{2m+1}.CO.C_{17-m}H_{35-2m}$, with m equal to 3, 4, 5, 6 and 7. The multiphase form of the mixture is stable up to the melting point at 27·5° C., but the metastable single-phase form, which shows a polymorphic transition at 13·5–15·5° C., can be preserved indefinitely above the temperature of this transition. On cooling below this temperature, complicated phenomena occur in the mixture which find expression in its dielectric properties.

The accompanying graph shows the dielectric constant of the mixture at 800 c./s., during different heat-treatments. Curve 1 was obtained during cooling of the specimen, while curves 2, 3 and 4 were obtained on heating after the specimen had been annealed for varying times at temperatures below 4° C. The longer the time of annealing, the smaller is the peak observed and the higher the temperature at which it occurs. Specimens annealed for some weeks retain their low dielectric constant up to the melting point, and their structure, as indicated by X-ray powder photographs, is that of the multiphase form.

The experimental evidence may be interpreted as follows. On cooling below the temperature of the polymorphic transition the mixture becomes capable of precipitation, and aggregates are formed which have comparatively high dielectric constants while they are small and/or imperfect. These aggregates are thermodynamically unstable, and on annealing at low temperatures they change gradually into more stable aggregates of lower permittivity. On reheating, the aggregates are dissolved, at a temperature which is the higher the more stable they have grown, and during their dissolution they pass again through the condition connected with high dielectric constants.

The evidence indicates a sequence of intermediate stages of precipitation, depending in a complicated way on time and temperature. In this respect the mixed ketones are analogous to age-hardening alloys[2], and their study might be of interest to metallurgists. Compared with alloys, the ketones offer two advantages for the investigation of precipitation: precipitating aggregates form the bulk of the material and are not dispersed in a matrix, and their properties can be studied by very sensitive dielectric methods.

The comparatively high permittivity of the precipitating aggregates is of interest from the point of view of dielectrics; even though the permittivity of the solid mixture remains below that of the liquid, the evidence indicates a possibility of obtaining high dielectric constants with some kinds of small or imperfect aggregates. The relaxation times of dipoles in such aggregates are also of interest. From the points of view of the theories either of phase changes in solids or of dielectrics, it would obviously be interesting to correlate the physical properties of the precipitating aggregates with their structure. Work on this is in progress.

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