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DIELECTRIC DISPERSION IN DOBAMBC*

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Abstract: From the low frequency order parameter fluctuation spectrum of chiral DOBAMBC at the ferroelectric smectic A to C transition, studied by dielectric relaxation spectroscopy, the frequency and dielectric strength of the Goldstone mode for q = 0 in the ferroelectric phase have been determined. The frequency is approximately temperature independent, decreasing slightly when approaching T_c from below, while the intensity decreases for an order of magnitude and goes to zero at T_c.

In our previous study[1] we have reported on the frequency and temperature dependence of the dielectric constant of *p*-decyloxybenzylidene-*p'*-amino 2-methylbutyl cinnamate (DOBAMBC) close to the smectic A to smectic C phase transition. The numerical analysis of the same experimental data gives some new information.

In Figure 1 is shown the temperature dependence of the Goldstone mode frequency in the smectic C phase. The circles represent the measured values of the relaxation frequency determined from the Cole-Cole diagrams.[1] The

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curve represents the fit calculated from a linear regression of log f vs log (T_c-T). The frequency of the Goldstone mode decreases on approaching T_c, where it has a

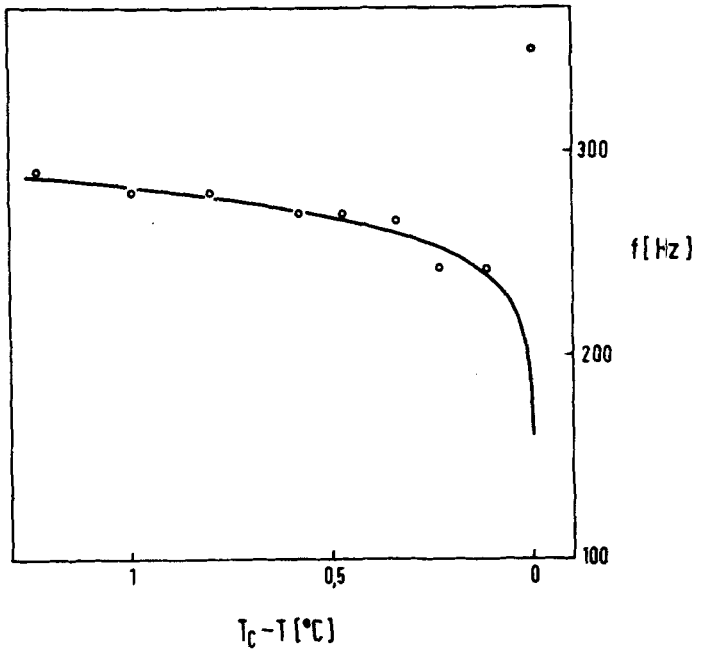

FIGURE 1: The dielectric dispersion frequency as a function of temperature

fixed value. The measured value at T_c is much higher than the extrapolated value.

Figure 2 shows the corresponding dielectric strength $\varepsilon_0-\varepsilon_\infty$ of the Goldstone mode as a function of temperature. The curve is calculated from a linear regression of log ($\varepsilon_0-\varepsilon_\infty$) vs log ($T_c$-T). As we supposed in the previous study, the intensity of the Goldstone mode really goes to zero at T_c. Again the measured value at T_c is much different from the extrapolated value.

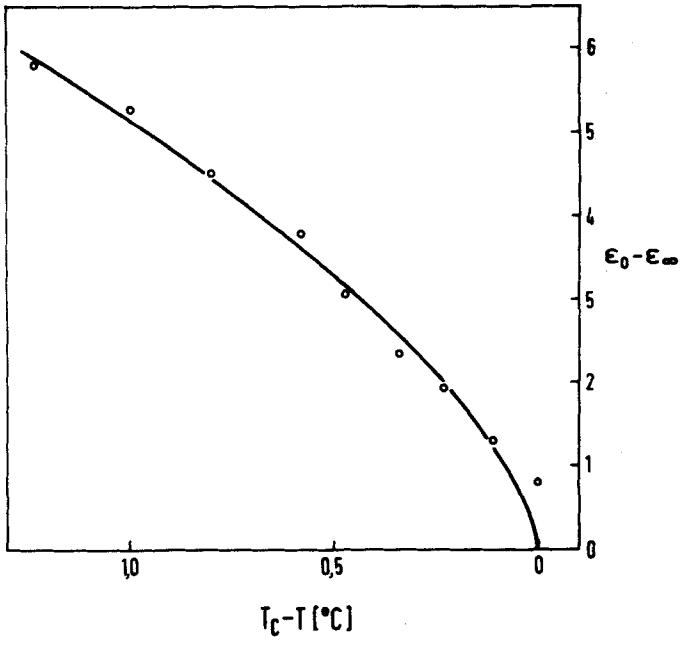

FIGURE 2: The dielectric strength as a function of temperature

The low frequency part of the polarization fluctuation spectrum is expected to have a soft mode behaviour above T_C, while below T_C, it should be a superposition of the soft mode part and the Goldstone part. The soft mode has been determined above T_C by Garoff and Meyer.[2] It is equal to 10 kHz at $T-T_C$ = 0.1 K and decreases critically when approaching T_C. As the dielectric intensity of the soft mode decreases rapidly[3] on going away from T_C, the greatest chance of observing it is just at the temperature of the phase transition. In Figure 3 we make a comparison of the experimental results and the theory developed in the study of Žekš.[3] Neglecting the flexoelectric coupling, the Goldstone mode has a constant value. Using values for viscosity, elastic constant, and pitch from the literature,[1] we get for the Goldstone mode frequency 250 Hz which is close to the measured value. The point at T_C corresponds to the

soft mode frequency which depends critically on temperature.

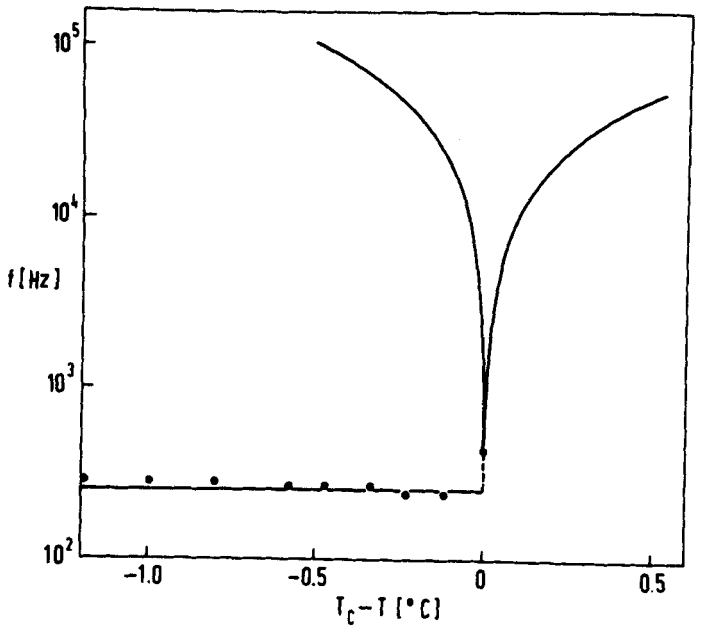

FIGURE 3: The temperature dependence of the Goldstone mode and soft mode.

CONCLUSIONS: With a least mean square analysis of the experimental data we have succeeded in showing that the intensity of the Goldstone mode goes to zero at T_c, and that the measured point at T_c corresponds to a soft mode. The dielectric properties of DOBAMBC close to the smectic A to smectic C transition can be very well described by the model proposed by Žekš.[3]

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