

Experimental Study of Critical Phenomena in TGS-Group Ferroelectrics

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Theoretical calculations for uniaxial ferroelectrics predict that the temperature dependence of the thermodynamic quantities differ logarithmically from classic behavior. Ferroelectrics of TGS-group which are believed to be typical examples of this case have been intensively studied by many workers, and logarithmic corrections have been observed in several quantities. In the symposium the results of our recent measurements on the specific heat, the thermal expansion coefficient, and the elastic compliance constant were reported. The measurements were carried out in a wide temperature region extending to 40~80 K above T_c , so that the anomalous part could be determined correctly. In each case, logarithmic (or at least nearly logarithmic) anomaly was observed in the range $T - T_c \lesssim 10 \sim 20$ K, which is far wider than earlier results. Figure 1 shows the anomalous specific heat ΔC_p plotted against $\ln(T - T_c)$. The data on the three substances were normalized so as to give the same transition entropy. It is seen that the curves for the three substances have almost the same slope, which means that the amplitudes of critical anomalies are nearly the same. This fact is remarkable because the magnitudes of the anomalies below T_c are quite different from each other (for instance, jump at T_c in TGSe is more

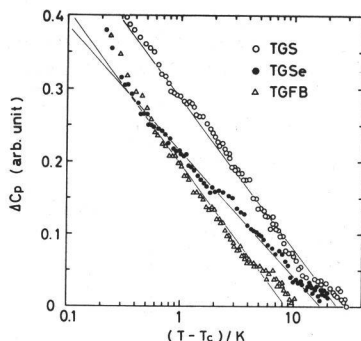


Fig. 1. Semi-logarithmic plot of anomalous specific heat ΔC_p .

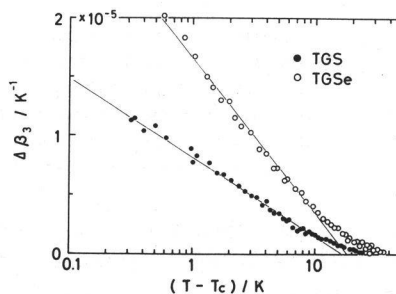


Fig. 2. Semi-logarithmic plot of anomalous thermal expansion coefficient $\Delta\beta_3$.

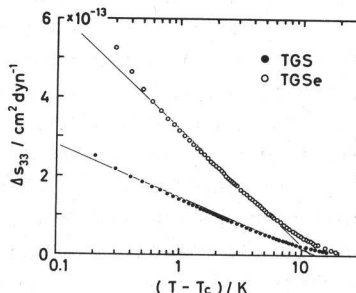


Fig. 3. Semi-logarithmic plot of anomalous elastic compliance constant Δs_{33} .

than five times larger than that in TGS). The results for $\Delta\beta_3$ and Δs_{33} are shown in Figs. 2 and 3. The results for the a^* - and b axes were similar and are not shown here. The values $\gamma_i \equiv -\partial T_c / \partial X_i$ calculated by use of the generalized Pippard equations from these anomalies were found to agree well with former results.^{1,2)} Below T_c , critical anomalies due to fluctuation of the order parameter are masked by large mean-field anomalies. In this respect the behaviors of C_p and s_{ij} at constant electric flux density, C^D and s_{ij}^D , are of special interest, because the mean-field anomalies are suppressed and only the fluctuation anomalies appear in these quantities. Preliminary results for s_{33}^D of TGS suggest the existence of critical anomaly below T_c .

References

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