Letters to the Editor

ANOMALIES OF THERMAL PROPERTIES OF TGS

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The aim of our work is to obtain more information about the behaviour of TGS at the phase transition by measuring specific heat (c), thermal conductivity (λ), thermal diffusivity (k) and differential enthalpic analysis in the temperature region 15°—55°C. Pure single crystals were obtained from the firm of *Monokrystaly Turnov*. The pulse method [1] was used for the measurements of the quantities λ, c, and k. The specific heat values are plotted in Fig. 1.

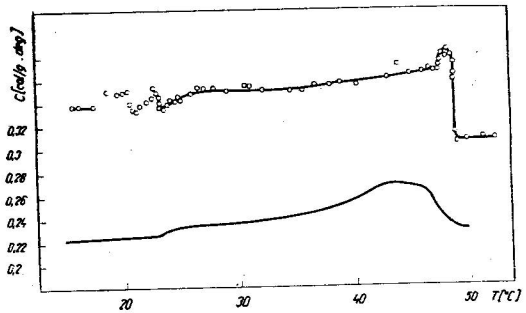

Fig. 1. The specific heat of TGS. The lower curve — Hoshino measurements [2], the upper curve — present measurements.

There are two differences between our and the Hoshino [2] measurements. The first difference is a greater drop of the specific heat curve in the temperature region 48°—49°C in our measurements. This supports the suggestion that the transition is not a simple order—disorder transition type suggested by Hoshino [2], but that there exist complicated structural changes in this temperature region. The other difference is that in the temperature region 19·5°—23·5°C, there exist specific heat anomalies resulting probably from changes in the TGS structure. This temperature region was also investigated by DEA (Fig. 2a, b).

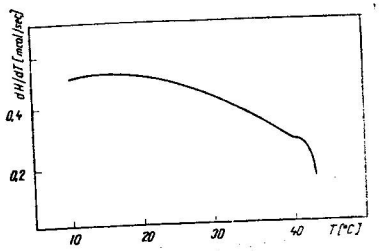

Fig. 2a. DEA curve of the first transition in TGS. Range 3 in cal/sec, scan speed 4°/min, chart speed 30 in/hr.

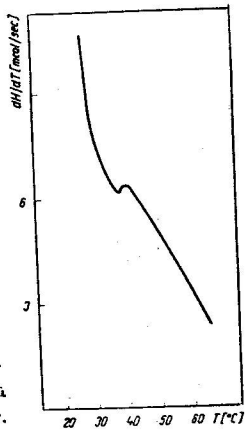

Fig. 2b. DEA curve of the second transition in TGS. Range 16 in cal/sec, scan speed 8°/min, chart speed 30 in/hr.

For DEA the Parkins-Elsner Differential Scanning Calorimeter Model DSC-IB was used. The amount of TGS was about 36 mg. Measurements were made at the lower temperature range (Fig. 2a) and also at the upper temperature range (Fig. 2b). The first transition (Fig. 2a) is irreversible. The second transition (Fig. 2b) is reversible and from the energetical point of view it is more conspicious than the first. No special calibration of temperature scales in either type of measurements was made.

Considering the Blinc NMR measurements [3], the phase transition in TGS can be described as a combination of an order-disorder transition of the 0 (III)—H-0 (II) hydrogens and G II and G III glycines with a displacive type transition of G I. Considering the Blinc description of the transition and the complicated TGS structure, the single transition types will be probably not realized at the same temperature. Our specific heat values are greater than those of Hoshino [2] by about 40 %. Thermal diffusivity values are plotted in Fig. 3. They increase suddenly at 48°C. According to the thermal conductivity theory we can write

$$k = \tfrac{1}{3} lv,$$

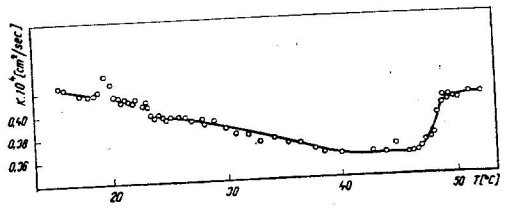

Fig. 3. The thermal diffusivity of TGS.

where l is the phonon free path and v is the sound velocity. Elasticity measurements in TGS confirm a drop in elastic constants at 48°C [4]. The sound velocity depends on the elastic constants. Then the main reason for an increase of the thermal diffusivity is the increase of the sound velocity.

The thermal conductivity values (Fig. 4) were calculated from the relation

$$\lambda = ck\varrho,$$

where ϱ is the density of the crystal.

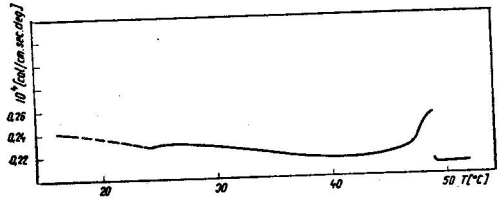

Fig. 4. The thermal conductivity of TGS.

A detailed study of the λ, c, and k measurements and the description of the pulse method will be published later.

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