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Thermal Expansion of Chromium Single Crystals at the Néel Temperature

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This note reports the discontinuous change in the thermal expansion of single crystals of pure chromium at T_N. Samples used were cut from a bottom-like ingots melted in a plasma furnace. The samples have resistance ratio $R_{273°K}/R_{4.2°K}$ of about 350. Measurements of the thermal expansion were carried out by the strain gauge method for two specimens (A and B), annealed for 1 hr and 2 hr, at 1200°C respectively. Figure 1 shows the result of the measurement of the thermal expansion near T_N for the specimen-B along the [011] direction in the (100) plane during the increasing temperature with a heating rate of 0.3 deg min^{-1}. The hysteresis of the thermal expansion near T_N during a single continuous heating-cooling cycle was not appreciated clearly. Figure 2 shows the coefficient of the thermal expansion near T_N for the different heat treated specimens. From the results of Fig. 2, it seems to be thought that the shape of the thermal expansion curve near T_N is structure sensitive.

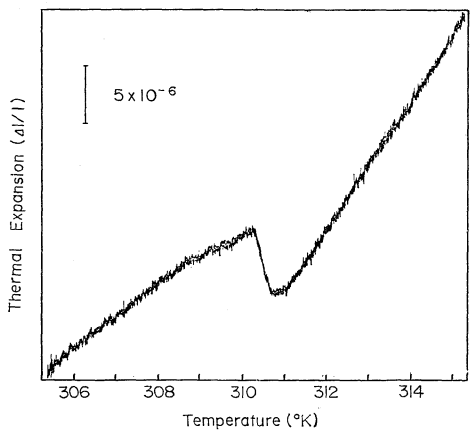

Fig. 1. Thermal expansion near T_N along [011] in the (100) plane.

Arrott *et al.*[1] have observed the first order transition at T_N in Cr single crystals by neutron diffraction study. However, there is no evidence suggesting the existence of a discontinuous change of volume[2] at T_N in Cr. As seen in Fig. 2, it appears that the coefficient of the thermal expansion are almost divergent near T_N and could be interpreted as the volume change due to the first order transition at T_N. The latent heat at

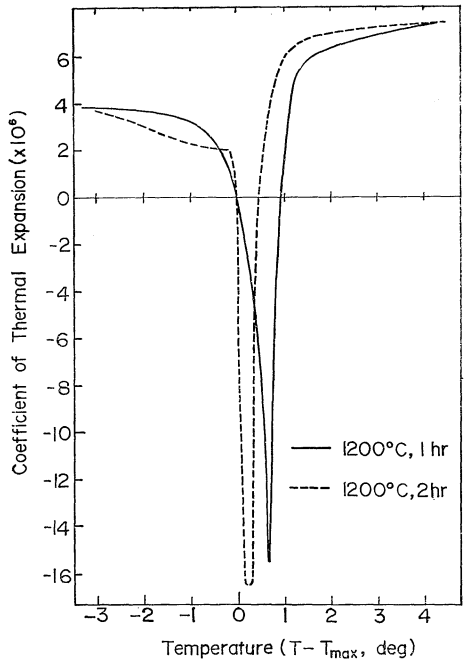

Fig. 2. Coefficient of thermal expansion near T_N for different heat treated specimens. T_{max}, the temperature of maximum thermal expansion, is 309.7°K for solid curve and 310.2°K for dashed curve.

T_N can be evaluated from dT_N/dp[3] and the volume change ΔV of the present data at T_N, using Clausius-Clapeyron formula, $dT_N/dp=\Delta V/\Delta S$. The latent heat evaluated is 0.23 cal mole^{-1}, and agrees reasonably with the measured value of specific heat near T_N obtained by Beaumont *et al.*[4] and Heiniger,[5] as considered due to phase transition of the first kind.

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