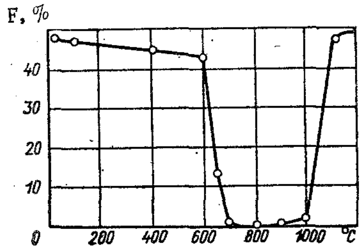

Fig. 2. Amount of δ ferrite in steel Kh28N10S4 in relation to reheating temperature.

The temperature range in which M_6C exists is 600-1000°, while π phase is found at all heating temperatures, from 300 to 1150°.

Even heating at 1220° (holding 1 h, cooling in water) does not lead to complete solution of this phase.

The hardness of steel Kh28N10S4 was HRC 35 after additional heating at 300° (1.8% π phase) and HRC 40 after heating at 500° (4% π phase).

Decomposition of δ ferrite and precipitation of M_6C are accompanied by a substantial increase of the hardness. After heating at 700° the hardness of the steel is HRC 50, while after heating at 800°, when the quantity of M_6C is largest, the hardness is HRC 55. When the temperature is raised to 900 and 1000°, the amount of M_6C decreases, which reduces the hardness to HRC 50 and HRC 45, respectively.

At 1150°, when the steel again consists of δ + γ + π phase (~4% π phase), the hardness decreases to HRC 30.

EFFECT OF TEXTURE ON THE SHAPE MEMORY EFFECT IN TITANIUM NICKELIDE

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The shape memory effect, observed in TiNi and other materials, is due to the cooperative shift of atoms in specific crystallographic systems (thermoelastic martensitic transformation [1-3]). The number of crystallographic variations of martensite is determined by the active systems of martensitic displacement. But if the transformation occurs under load, then the possibility of the formation of martensite of various

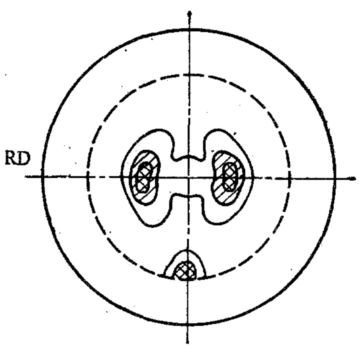

Fig. 1. {110} pole figure. Orientation (112) [$\bar{1}$10].

Translated from Metallovedenie i Termicheskaya Obrabotka Metallov, No. 9, pp. 62-63, September, 1979.

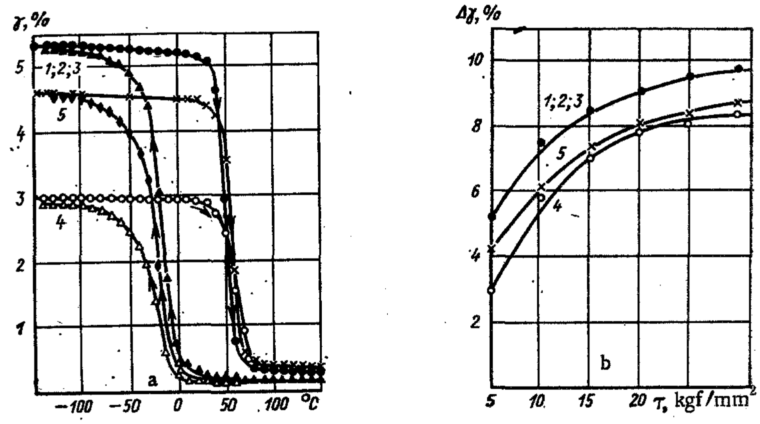

Fig. 2. Deformation during torsion with constant stress 5 kgf/mm^2 in relation to temperature (a) and maximal cumulative deformation in relation to applied stress (b). The samples were cut at different angles to RD: 0 (1), 22.5 (2), 45 (3), 67.5 (4), and 90° (5).

modifications is limited in relation to the orientation of the plane and the direction of the martensitic displacement with respect to the applied load [4]. For this reason, one would expect a distinct deformation texture or annealing texture to cause anisotropy of the shape memory effect.

We investigated the effect of texture on the shape memory effect of Ti + 50 at.% Ni. After electric arc remelting, the ingot was forged and hot rolled to a sheet 1 mm thick.

The texture was determined by means of the DRON-2 diffractometer with use of the GP-4 attachment. The central section of the pole figure was plotted by the method suggested by Shultz from reflection (110). The texture obtained was described by means of the ideal orientation [5]. The shape memory effect was investigated on samples 1 × 1 mm in section and 50 mm long cut by spark machining from the sheet at angles of 0, 22.5, 45, 67.5, and 90° to the rolling direction (RD). The surface of samples for mechanical tests (and also for x-ray analysis) was etched to a depth of 0.1 mm in the solution described in [6].

The samples were tested by the torsional oscillation method, permitting constant torque to be created in the sample.

Analysis of the pole figure showed that the texture of the sheet can be described by the ideal orientation (112) [$\bar{1}$10] (Fig. 1).

The results of torsion tests of samples with different orientations with respect to RD are shown in Fig. 2a.

It can be seen that deformation is largest in samples cut at angles of 0, 22.5, and 45° to RD, somewhat smaller for samples cut at an angle of 90°, and much smaller at an angle of 67.5°. This relationship is retained with increasing torsional stress up to 30 kgf/mm^2 (Fig. 2b), although the difference decreases with increasing load. A relationship was also found between the initial temperature of the martensitic transformation under load M_s^τ and the orientation of the axis of the sample in relation to RD (30-50°). The larger the deformation, the higher M_s^τ. The initial and final temperatures of the reverse martensitic transformation — A_s^τ and A_f^τ — under load vary within limits of 10-15°C (the larger the deformation, the lower A_s^τ and A_f^τ).

CONCLUSIONS

1. Anisotropy of the shape memory effect in TiNi due to the rolling texture was established. The anisotropy may be substantial for the operating characteristics of the material.

2. The largest cumulative deformation was observed with the axis of the sample near the rolling direction.

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