Therefore, in use of nickel foils as a structural element of temperature-sensitive elements it is desirable to stabilize anneal in the 350-450°C range.

LITERATURE CITED


FORMATION OF THE BASE TEXTURE IN VT18u TITANIUM ALLOY

I. V. Égiz, A. A. Babaréko, A. I. Khorev, M. M. Martynova, and E. B. Samarin

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In development of heat-treat cycles for alloys with a hexagonal close-packed structure special attention must be devoted to the crystallographic orientation (texture) formed in working and having a significant influence on the production and service properties of alloys. Requirements for plastic isotropy in the plane of the sheet are frequently imposed on titanium pseudo-α-alloys in the form of rolled sheets. For this, titanium alloy sheets must possess a base orientation in the direction of the normal to the rolling plane. It is known that the base (deflected base) texture is formed under certain deformation conditions.

One of the mechanisms of deformation promoting formation of the base texture in alloys is slip of 1/3a(1120) perfect unsplit dislocations in the planes of a prism, pyramid, and base with accumulation of them in the crystalline lattice, causing by rotation a smooth change in its orientation in the normal direction from the prism to the base [1]. For the possibility of formation of such a texture rolling must be done with a high degree of reduction at a relatively low temperature in a condition in which the α-phase predominates in the volume of the alloy. The fraction of the base texture in such rolling reaches 60-70% at an angle of dispersion of ~45°. In addition, shear deformation [2] in rolling promotes formation of the base texture in the surface and subsurface layers. In the center layers of the sheet a deflected base texture is also formed as the result of the β(111) → α(1124) martensitic transformation under load if in rolling the alloy has an (α + β) structure [3]. Finally, twinning in type {1012} (1011) systems makes it possible to reorient a material with a prismatic orientation in the normal direction into a deflected base orientation according to the (1120) [0001] → (1124) [1100] transformation. To provide twinning rolling must be done along the c axis [4]. It is known that in direct rolling at temperatures below the temperature of the forward martensitic transformation as the result

*The axes of the texture are given for the normal direction, rolling direction, and transverse direction, respectively.
of the $\beta(001) \rightarrow \alpha$ transformation a texture with the axes $(11\overline{2}0) [11\overline{0}0] [0001]$ is formed in the $\alpha$ phase. To roll along the $c$ axis an alloy with such a texture, it is necessary to change the rolling direction by 90°, i.e., to cross roll the alloy. In such rolling, twinning must occur intensely since in this case the possibility of easy slip is eliminated. For complete retwinning of an alloy with quite small reductions (10%), i.e., in cross rolling, large degrees of deformation are not required.

In this work VT18u pseudo-$\alpha$-alloy of the Ti--Al--Zr--Nb--Mo--Si system with addition of tin was investigated [5]. Experience has shown that as the result of direct rolling of this alloy with a total reduction of 80% at 900°C with finishing of it at 850°C it is possible to obtain ~80% of the volume with base and deflected base orientations, and in the remaining portion of the volume a continuous transition of the orientations from the $(1\overline{1}20)$ prismatic to the $(1\overline{1}22)$ pyramidal and then to the $(1\overline{1}24)$ and the $(10\overline{1}3)$ occurs. Based on theoretical concepts recommending different plans of rolling to obtain the necessary crystallographic orientations transverse rolling with a reduction of 30% after the finish of direct rolling was proposed in order to make possible twinning of the alloy possessing in the normal direction a prismatic orientation and pyramidal orientations close to it.

A 5-mm-thick rolled plate of VT18u alloy was rolled at 900°C to a thickness of 2.5 mm and then cross rolled to a thickness of 1.6 mm at 950, 900, 850, and 800°C. Plates with an area of 20 × 20 mm were cut from the sheets of final thickness for x-ray diffraction investigation. The x-ray diffraction pattern was recorded on a DRON-2 instrument by recording the full Debye spectrum from three orthogonal cross sections: the rolling plane and sections normal to the rolling direction and the transverse

![Fig. 1. Reverse pole figures of the normal direction of the center layers of VT18 alloy sheets rolled under different conditions: a) direct rolled at 900°C; b) the same + cross rolled at 950°C; c) direct rolled at 900°C + cross rolled at 800°C; d) the same + annealed at 900°C for 1 h.](image)

![Fig. 2. Change in normal direction texture of the center layers of rolled VT18u alloy sheets in relation to cross-rolling temperature: a) fraction of base texture at an angle of dispersion of 45° to the c axis: •) after direct and cross rolling; ×) the same + annealing at 900°C for 1 h; b) fractions with [(11\overline{2}2) + (1233)/2 orientations (curve 1) and (1\overline{1}20) orientation (curve 2); data are given for cross-rolled sheets not subsequently annealed.](image)