Cold rolling evolution in high purity niobium using a tapered wedge specimen

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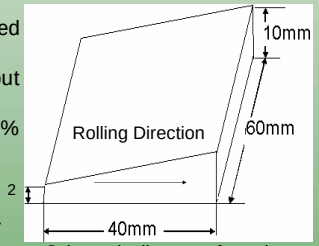
Abstract

A tapered wedge niobium specimen was rolled at room temperature with multiple passes in the same direction without lubricant and then annealed at 750° C for 1 hour. The crystal orientation distribution of the 50, 70%, 80%, 90% deformed samples was investigated using x-rays to obtain a quantitative texture analysis. The initial rotated cube (001)<110> texture was largely retained up to about 70% reduction in the interior of the samples. After 80% rolling deformation the initial texture vanished and revealed a {111} fiber texture in the interior, which remained stable during annealing. With 90% reduction, the {111} fiber texture become somewhat stronger. In the surface layer, the {001} fiber orientation remained stable but after annealing, the surface texture sharpened to become {001}<110>

Experimental procedure

As-received Nb (RRR=150) tapered specimens
Unidirectional cold rolling without lubrication at room temperature
The maximum reduction reach 90% after six reductions
Roll Diameter = 102 mm
Roll Speed = 102 mm/s
L/H≈4 ⇒ strain penetrates to center



Schematic diagram of specimen

After rolling, the specimen was sliced along the rolling direction to make 8 equal size strips

Three incomplete (200), (220) and (111) pole figures of surface, the quarter thickness (0.4 mm) layer were measured

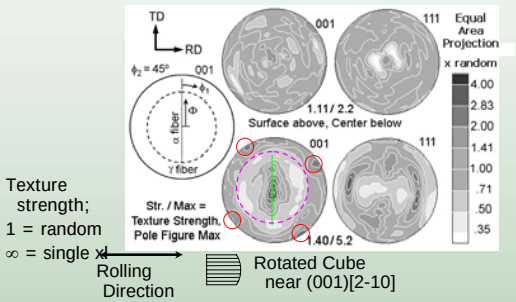
A strip from the center was annealed at 750 for 1 hour in evacuated quartz tube heated slowly in furnace

Pole figures of surface and quarter thickness (0.4 mm) of annealed specimen were measured

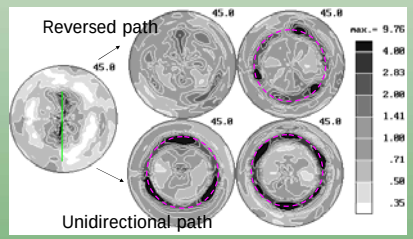
Post processing with popLA software, WIMV recalculated PFs presented

OIM data was collected by Camscan SEM for through thickness measurement

Texture of *initial Nb* plate is rotated cube; weaker on surface

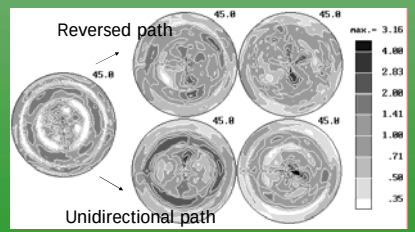


Initial Rolled Annealed

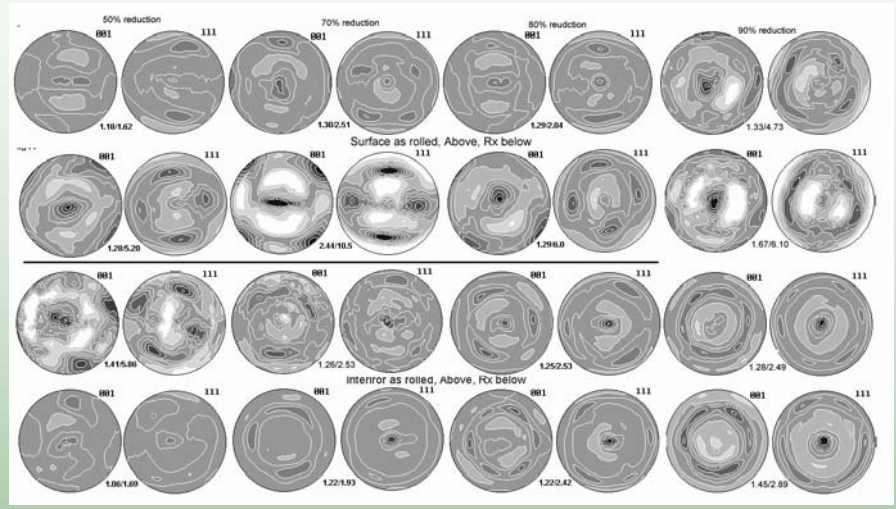


In the ***center,*** After rolling, the α fiber deceased, γ fiber increased. After annealing, the γ fiber becomes very strong

Initial Rolled Annealed



On the **surface**, After rolling, α fiber unchanged, slight γ fiber increase. After annealing, the γ fiber weakened



Evolution of recrystallization textures from cold rolling textures in Nb

Conclusions

1. The major components of cold rolling textures depend on the cold rolling reduction and rolling conditions. After 70% reduction, the {111} fiber dominates in the center of layer, but {001} fiber dominates on the surface
2. The major components of the recrystallization textures are {111} fiber in the center of layer, {001}<110> dominates on the surface after annealing
3. The intensity of recrystallization textures depend on the cold reduction. With 90% reduction, the {111} fiber becomes stronger
4. Processing path affects the texture. unidirectional rolled specimen has more homogenous textures than reversed rolled specimen

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