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## Technical Note

# Notes on a Molybdenum-Rhenium Alloy

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DURING the course of an investigation of materials suitable for use as thermocouples at elevated temperatures by one of the authors, several molybdenum-rhenium alloys were prepared. Micrographs of an annealed alloy containing 25 pct Re (intended concentration; analysis not obtained) showed a number of twins, Fig. 1, suggesting a face-centered cubic structure. This note reports the structure and recrystallized wire texture of an alloy containing 25 wt pct Re.

Alloys were prepared from 99.9 pct Mo (Fansteel Metallurgical Corp.) and rhenium obtained from the University of Tennessee (purity unreported). Powders were combined and briquetted at 56,000 psi and sintering was carried out at 2400°C for 5 hr

Table I. X-Ray Data for 75 Pct Mo-25 Pct Re Alloy

Hkl	d(Obs.)	d(Cal)*	I(Obs.)
111	2.180	2.190	ms
200	1.846	1.852	s
220	1.306	1.309	s
311	1.115	1.117	m
222	1.065	1.069	m
400	0.9250	0.9259	mw
331	$\alpha_1$ 0.8479	0.8496	m
331	$\alpha_2$ 0.8492		mw
420	$\alpha_1$ 0.8278	0.8281	ms
420	$\alpha_2$ 0.8279		m

$A_0$  (extrapolated to  $\theta=90^\circ$ ) 3.703Å.

\* Calculated from value of  $A_0$ .

m, medium; ms, medium strong; s, strong; mw, medium weak.

in vacuum. Ingots so prepared were swaged at 982.2° to 1037.8°C into wires 0.036 in. diameter, a reduction in diameter of 85.6 pct. These wires were vacuum-annealed 1 hr at 2000°C.

A North American Philips 114.59 mm powder camera and nickel-filtered copper radiation were used for structure determination. For the texture determination a Laue-type camera was used with zirconium-filtered molybdenum radiation and, because of the high background, aluminum foil was mounted next to the film. Exposures were taken with the wire perpendicular to the X-ray beam and tilted by 10°.

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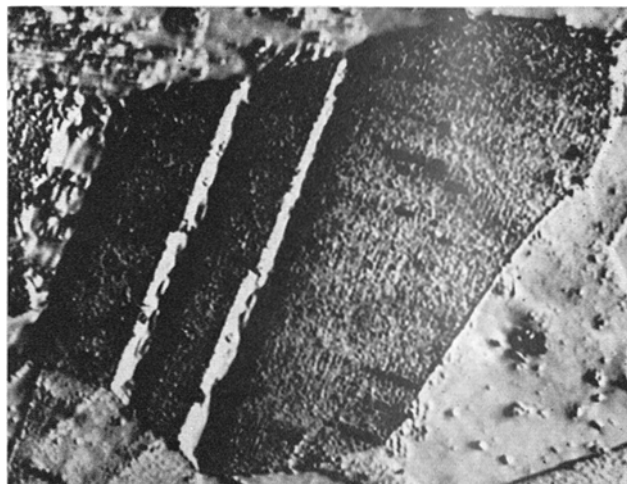


Fig. 1—Annealing twins in 75 pct Mo-25 pct Re alloy annealed 1 hr at 2000°C. Etch: 1 part HNO<sub>3</sub>; 2 parts H<sub>2</sub>O; 3 parts HCl. X2000. Area reduced approximately 85 pct for reproduction.

It was found that the X-ray pattern could be indexed on the basis of a face-centered cubic structure. Because of difficulties associated with obtaining a good X-ray pattern for this material, accurate parameter determinations were not made. An indicated parameter value of 3.70Å was obtained. The X-ray data are given in Table I.

The annealed wire texture was observed to be a sharp [111] texture. The spread about this fiber axis was  $\pm 8^\circ$  at the surface of the 0.036 in. wire. The annealed wire textures of aluminum have been reported as retention of the [111] deformation texture for anneals below 500°C and a new [112] texture for anneals above 600°C.<sup>1</sup> In copper wires, with a [111] plus [100] deformation texture, results indicate a retention of this texture for annealing at lower temperatures and new components or the disappearance of components for annealing at higher temperatures.<sup>1</sup> The presence of the strong [111] texture in the molybdenum-rhenium alloy after a 2000°C anneal suggests that the deformation texture was the same.

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<sup>1</sup>C. S. Barrett: *Structure of Metals*. (1952) New York. McGraw-Hill Book Co.