Deformation and Recrystallization Texture Of Cold-Drawn OFHC Copper Wire

by W. A. Backofen

THE texture of cold-drawn copper wire has been described most often as a composite of $[111]$ and $[100]$ directions aligned parallel to the wire axis.¹ Hibbard² suggested that sufficient reduction will result in a single $[111]$ texture and reported that after a reduction in area of 96.4 pct, such a texture was nearly obtained. Other work^{3, 4} has shown that recrystallization within the temperature range of 300° to 1000°C does not alter the texture established by cold-drawing. In general, however,

directions aligned parallel to the wire axis. Supplementary measurements with a Geiger-Mueller counter of the intensity of reflection from (111) planes showed that the $[111]$ component was much more predominant than the $[100]$.

Additional specimens of the drawn and etched wire were annealed in a salt bath at temperatures from 300° to 450°C. The texture of the recrystallized wire was studied with the same technique applied to the cold-drawn wire. Fig. 1b is an X-ray

Fig. 1—X-ray photograph of OFHC copper wire.

a (left)—Cold-drawn 97.3 pct. b (right)—Cold-drawn 97.3 pct and annealed for 1½ hr at 300°C.

The wire axis is in the vertical position. The inner diffraction ring is from $\{111\}$ planes. The outer diffraction ring is from $\{200\}$ planes.

the texture of cold-drawn and annealed copper wire is not as well defined as the deformation texture. In the work reported here it was found that the double-fiber, deformation texture persists even after a reduction in area of 97.3 pct, and after recrystallization the texture is practically all $[100]$.

The wire used in this work was prepared in the following way. A ¾-in. diam length of annealed OFHC copper was cold-drawn to a diameter of ⅛ in., a reduction in area of 97.3 pct. Each step in the drawing operation brought about a reduction in area that varied from 6 to 10 pct. Short lengths of this wire were etched in a 50-pct solution of nitric acid to a diameter of approximately 0.01 in.

The texture of the cold-drawn specimens was determined with the conventional X-ray transmission diffraction technique using filtered copper radiation. The X-ray beam was directed perpendicularly to the wire axis and the diffraction rings were recorded on a flat film. Fig. 1a is typical of the photographs obtained and reveals that the cold-drawing schedule described above introduces a distinct, double-fiber texture with both $[111]$ and $[100]$

photogram of a specimen annealed for 1½ hr at 300°C and is typical of those obtained from recrystallized specimens. The photogram shows that recrystallization of this material is accompanied by the almost complete elimination of the $[111]$ component of the deformation texture. A pronounced strengthening of the $[100]$ component was evident from intensity measurements with a Geiger-Mueller counter.

In summary, the deformation texture of cold-drawn OFHC copper wire, after a reduction in area of 97.3 pct, may still be described as a composite of $[111]$ and $[100]$ directions aligned parallel to the wire axis. Recrystallization of such wire at temperatures from 300° to 450°C introduces a texture which consists almost entirely of a $[100]$ alignment.

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References

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