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Effect of Composition on the Wire Textures of Copper and Its Solid Solution Alloys

WALTER R. HIBBARD, Jr.,* Junior Member AIME

It has been proposed¹ on the basis of slip and flow that the ideal deformation texture of drawn wire for face-centered cubic metals is a (111) direction parallel to the wire axis. Under these considerations, an intermediate [100] texture is permissible but should eventually change to the stable [111] orientation. This theory does not explain why copper and its alloys containing up to about 80 pct nickel, 5 pct zinc and 1 pct aluminum were found to have a double [111], [100] texture, while alloys with at least 8 pct zinc and 2 pct aluminum developed essentially a single [111] texture.^{1,2} It does suggest, however, that the [100] component of the former alloys should disappear with additional deformation.³ Some evidence exists to support this suggestion. Howald⁴ reported that annealed copper wire previously drawn 93.8 pct and 98.5 pct developed a single [111] texture. Since, in wire, the drawn and annealed textures are similar, these wires probably had a single [111] deformation texture before annealing. In addition, although cold rolled polycrystalline copper and 80-20 brass were found to form different types of pole figures,^{5,6} single crystals of these metals when rolled from the stable (110) [112] orientation were found to produce essentially the same pole figure.^{7,8} It may be, therefore, that while the addition of solute elements changes the path by which the final

texture is obtained, the final texture is not changed.

Experimental Results

The wires remaining from the previous investigation¹ already drawn about 50 pct reduction in diameter were further drawn to 86 pct and then to 96.4 pct total reduction in diameter. The textures were determined after these stages by transmission X ray photograms taken with a copper K-alpha beam rotated θ degrees toward the wire axis. It was found that the ratio of the [111] and [100] intensities of the double texture in copper and its alloys containing 0.94 pct aluminum, 30.70 pct nickel, 2.61 pct zinc and 4.99 pct zinc increased from about 3:1 for the 50 pct reduction to about 9:1 for the 86 pct reduction. After 96.4 pct reduction, these wires exhibited essentially a single [111] texture.

Summary

Thus, the drawn wire deformation texture of copper and its alpha solid solution alloys containing aluminum,

nickel or zinc is essentially a single [111] texture as predicted by theoretical considerations of slip and flow.¹ For copper and its alloys containing up to about 1 pct aluminum, 5 pct zinc and at least 30 pct nickel, an intermediate [100] component is found after about 50 pct reduction in diameter, but disappears after about 95 pct reduction in diameter. For alpha solid solution alloys containing at least about 2 pct aluminum and 8 pct zinc the single [111] texture is developed considerably more easily and is found after about 50 pct reduction in diameter. No explanation of this compositional effect is apparent. Similar work is contemplated for cold rolled and cold compressed alloys.

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* Assistant Professor of Metallurgy at Yale University, New Haven, Conn.

¹ References are at the end of the note.