a considerable portion of the material within each kink-band retains its original orientation. Even though such a region essentially retains its average orientation, it becomes subdivided into a large number of small domains of slightly deviating orientations. This complete recovery without orientation change apparently corresponds to the process designated by Crussard[2] as "recrystallization in situ" and by Orowan[3] as "polygonization"; it now turns out to constitute a major part of the softening process in highly deformed (e.g. 95 pct rolled) high purity aluminum. Microscopic observations indicate, in addition to polygonization, the occurrence upon annealing of two sets of recrystallized grains corresponding to two new orientations, within each region having predominantly a single orientation in the as rolled condition. The orientation of one set of recrystallized grains growing in regions predominantly of the *a* orientation, as rolled, corresponds quite well with a *b* orientation of the deformed material, and vice versa. As seen in the pole figure (Fig. 1) an *a* and a *b* orientation have a common [111] pole; the relationship between these two orientations is equivalent to a [111] rotation of about 38°. The importance of this orientation relationship in recrystallization has been previously demonstrated for slightly deformed single crystals[4] and for highly rolled and compressed single crystals of high purity aluminum[5]. It now appears to govern as well the re-orientation upon recrystallization in polycrystalline 2S aluminum after high deformations. Both the "recrystallization in situ" and the re-orientation of the type described result in the retainment of the deformation texture upon annealing.

The orientation of the second set of recrystallized grains growing upon annealing is very similar everywhere in the rolled specimen, regardless of the local orientation of the region in which the new grains are growing. By means of color, it is possible to identify this orientation as one with a cube face parallel to the specimen surface. This set of new grains then corresponds to the "cube orientation" (100), [100], which is formed during annealing, as seen in the pole figure. It is remarkable that a [111] pole of the recrystallized "cube grains" approximately corresponds to a [111] pole of each of the four matrix orientations; the formation of the cube orientation component of the annealing texture can be also described approximately as a [111] rotation of 40°. As found previously[1], a re-orientation of this type is the result of the orientation dependence of the rate of grain boundary migration.

This work was supported by the Office of Naval Research, U. S. Navy, Contract No. N6ori-165, T.O. 1.

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Order-disorder Phase Change in Cu_3Au Alloys

by F. N. Rhines

TRANSFORMATION from the disordered to the ordered state, and the reverse, has been followed by electrical resistivity measurements, in which equilibrium has been established for each increment of temperature change, in Cu-Au alloys, ranging in composition from about 20 to about 32 atomic pct of gold. Equilibrium was attained very quickly at temperatures above the transformation; up to three weeks was required within the transformation interval and a matter of a day or two below the temperature interval of transformation. The temperature-resistivity curves have two sharp inflections corresponding to the limits of the transformation interval, the temperature spread between these inflections being least near 25 atomic pct of gold (Cu_3Au) and greater the more the composition departs from this value.

A nearly exhaustive survey of the literature upon order-disorder transformations has revealed a number of cases in which a sharply defined temperature interval of transformation has been reported for other alloy systems. Moreover, it has been found that the absence of such finding has generally been associated with tests run under conditions that are not expected to ensure the attainment of equilibrium.

It is concluded, upon the basis of this and other evidence, that the order-disorder transformation proceeds as a classical Gibbsian phase change. Ordering is believed to occur by a nucleation and growth process. Except at the ideal composition of Cu_3Au (which has virtually no effective composition range, but exists only at a sharply defined composition), the ordered and disordered phases are capable of coexistence at equilibrium within the transformation interval, i.e. the two-phase region of the phase diagram. It is recommended, therefore, that phase diagrams involving order-disorder transformations be drawn in accordance with the requirements of the Phase Rule.

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