Re-solution of Precipitated Silver in Copper-Silver Alloys

by Harold Margolin and Walter R. Hibbard, Jr.

DURING preliminary tests on the aging of a Cu-plus 5 pct Ag alloy,¹ a specimen which had been overaged 24 hr at 550°C was annealed in a nitrogen-hydrogen atmosphere first for 2 hr and then for an additional 28 hr at 600°C. After each anneal the specimen was cooled to room temperature in about ½ hr and X-ray photograms were made. The first film, Fig. 1a, revealed two sets of copper-base lines, one intense and corresponding to the parameter at 550°C, the other fainter and shifted away from the beam, corresponding to the larger parameter at 600°C (see arrows). The 30-hr film, Fig. 1b, revealed the same two sets of copper-base lines with a reversal of intensity. In neither case do the copper lines form a broad band which would be indicative of a range of compositions. This phenomenon is thus a "discontinuous" type of solution. A similar phenomenon was observed in a Ag-rich Cu-Ag alloy.² Finlay and Hibbard³ have suggested that directional rather than random solution of precipitate occurs in some alloys.

Conceivably, for Cu-Ag alloys, the matrix-transition-precipitate precipitation sequence is reversible for the re-solution of the precipitate caused by rapidly raising the annealing temperature of an overaged specimen. A copper-base transition structure supersaturated with solute might be formed around the precipitate as it dissolves, thus obviating the necessity for a gradually changing solute composition of the matrix. The solute atoms then might be transferred rapidly and locally from the transition to the matrix phase in the proper amount and at the proper location to obtain directly the new ex-

Fig. 1a (top)—Cu-Ag alloy aged 24 hr at 550°C, annealed 2 hr at 600°C.

Fig. 1b (bottom)—Same as Fig. 1a, but annealed 30 hr at 600°C.

panded solid solution. The theory implies a minimum of diffusion of solute in the matrix (i.e., no significant range of matrix composition) and possibly suggests that the composition of the transition structure will vary with the conditions of re-solution. A transition copper phase found in aged Cu-Ag alloys¹ might fulfill this function.

Evidence regarding this suggestion could be obtained in Cu-Ag alloys by overaging a specimen until no trace of the expanded copper lattice is present and then subjecting the specimen to a retrogression treatment. Re-appearance of the transition copper phase would confirm the theory. Additional details could be secured by varying both aging and retrogression temperatures.

References

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Technical Note

Fractographic Pattern for 475°C Embrittlement in Stainless Steel

by Carl A. Zapffe

FOR a number of years a puzzling phenomenon of brittleness in Class II ferritic stainless steels, developing in the temperature range near 475°C, has received increasing attention, but its nature remains essentially unknown. During an investigation of the fractographic structures in stainless steels, conducted in the author's laboratory the past several years, principally under sponsorship of the Office of

Naval Research, some observations of a new kind were found for "475°C embrittlement."

While the details of the study cannot be given here,¹ three fractographs will suffice to carry the

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