Letters

Ordered Precipitates in Quenched Cu_3Au Alloy

Short-range order can develop in Cu_3Au alloy, during the quench from temperatures above the critical ordering temperature [1-4]; the degree of order depends on quenched-in vacancies, which in turn depend on the temperature and the rate of quenching [5-7].

Electron diffraction patterns with weak superlattice spots are found after slow quenching from 850° C and annealing for 1 h at 200° C in stoichiometric Cu_3Au alloy specimens (see fig. 1). In transmission electron microscopy micrographs it is possible to observe, in some cases, the defects shown in figs. 2, 3, and 4; these defects are very thin and lie along ⟨100⟩ directions, perpendicular to the operating reflection vector $\vec{g} = \langle 200 \rangle$ (see figs. 2 and 3). When a normal reflection $\vec{g} = \langle 200 \rangle$ operates, the defects are in contrast along both ⟨100⟩ directions.

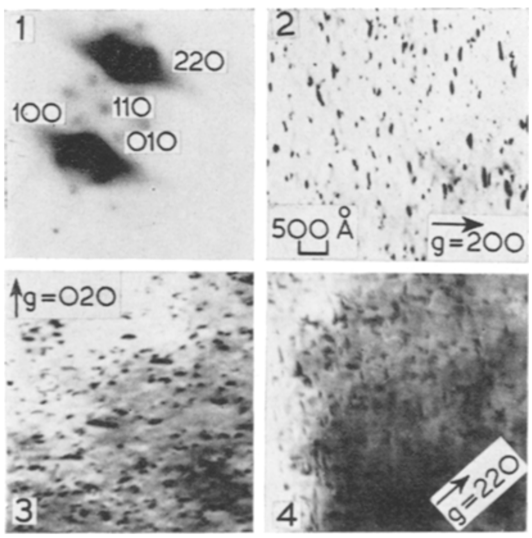

Figure 1 Diffraction pattern of Cu_3Au slowly quenched from 850° C. The weak superlattice spots are shown. *Figures 2 to 4* Ordered precipitates in quenched Cu_3Au.

The contrast is similar to that observed at the coherent precipitates [8] and it may be due to the lattice deformation produced by the precipitate on the matrix. In this case the precipitate may be observed if $\vec{g} \cdot \mathbf{R} \neq 0$, namely if the direction of the maximum misfit vector $\vec{\mathbf{R}}$ is not normal to $\vec{g}$. The contrast is maximum when $\vec{\mathbf{R}}$ lies perpendicular to the electron beam and parallel to $\vec{g}$; in other words, when the precipitates are perpendicular to the vector $\vec{g}$ and when the electron beam direction is close to ⟨100⟩, as observed in this case.

The production of superlattice spots is due to some degree of order inside the precipitates and/or to short-range order in the matrix.

This type of observation is rather rare; therefore the most favourable hypothesis seems to be that the observed quenched zones are off-stoichiometric in composition; the precipitates could then be due to an ordered Cu_3Au II phase in a disordered solid solution and could consist of thin ordered platelets on the {100} planes. The precipitation of these platelets could be aided by vacancy supersaturation. The Cu_3Au II phase in the ordered state has a tetragonal structure [3] and this could explain the observed strain field. Further investigations are in progress on Au-Cu alloys having a different composition.

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A. CAMANZI
G. SCHIANCHI
Istituto di Fisica dell'Università
43100 *Parma* (*Italy*)