

MICROSTRUCTURE INVESTIGATIONS OF Ag-In ALLOY
RAPIDLY QUENCHED FROM THE MELT

V. Franetović, A. Kirin, A. Bonefačić
Institute of Physics of the University of Zagreb

From theoretical considerations it may be expected that stacking fault energy /SFE/ decreases with increasing valence electron concentrations /VEC/ and goes through zero while passing through the mixed phase region /f.c.c. and h.c.p./¹. It is therefore reasonable to suppose an increase of SF concentration in that region. Investigations of SF concentrations and measurements of SFE could also contribute to the knowledge of SF importance in the transition from f.c.c. to h.c.p. structures. SF concentrations and SFE were measured by transmission electron microscopy and X-ray measurements were also carried out in order to examine the defects which influence the broadening of diffraction lines.

In the experiment several equilibrium concentrations /from 10 to 30 at.% In/ of Ag-In were prepared and rapidly quenched from the melt. These concentrations lay in f.c.c., f.c.c.+ h.c.p. and h.c.p. phase regions where there is a great probability of stacking faults emerging.

Due to rapid quenching the phase boundary was displaced towards minor VEC-s and so the terminal solid solubility decreased. This result differs greatly from the increased terminal solid solubility generally found in other systems. Thus we concluded that h.c.p. is energetically more favourable than the f.c.c. structure in the rapidly quenched alloys of our system. From the analysis of X-ray pattern peaks² and after measuring the positions and profiles of diffraction lines it was concluded that the main source of line broadening was a distortion of the crystal lattice. The measured root mean square strains

$1/\langle \varepsilon^2 \rangle^{1/2}$ were:

$\langle \varepsilon^2 \rangle^{1/2} = 6, 2 \cdot 10^{-4}$ for the direction $\langle 111 \rangle$ and $L = 30 \text{ \AA}$
 and $\langle \varepsilon^2 \rangle^{1/2} = 7, 6 \cdot 10^{-4}$ for the direction $\langle 200 \rangle$ and $L = 30 \text{ \AA}$,
 L being the distance normal to the reflecting planes $\{111\}$
 and $\{200\}$, respectively.

This distortion of the crystal lattice was probably the result of the great temperature gradient during the quenching process. Observation of equilibrium samples and quenched samples in a transmission electron microscope confirmed an increase of SF concentration in the quenched samples.

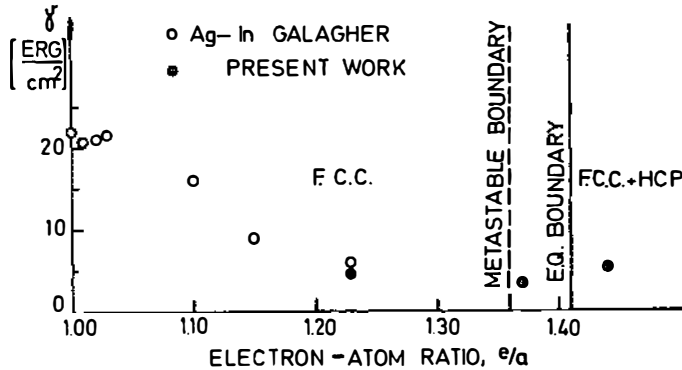


Fig.1-Variation of the stacking fault energy with e/a in Ag-In alloy

The SFE-s were established using the technique of direct observation of dislocation configurations³, the theory of Siems⁴ and the method of measurement of extended dislocations. Calculated SFE-s are presented in Fig.1 versus electron concentrations parallel with the result of Gallagher⁵ whose measurements were made on equilibrium concentrations for the same system. The phase boundary shift is also marked in Fig.1. As can be seen the SFE-s have very low values while passing through the mixed phase region.

References

- 1) T.C.Tisone, R.C.Sundahl and G.Y.Chin, *Met.Trans.* 1 (1970) 1561
- 2) B.E.Waren, *X-Ray Diffraction*, Addison-Wesley, Reading, Massachusetts, 1969.
- 3) A.W.Ruff Jr., *Met.Trans.* 1 (1970) 2391
- 4) R.Siems, *Disc.Faraday Soc.* 38 (1964) 42
- 5) P.C.J.Gallagher, *Met.Trans.* 1 (1970) 2429