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EFFECT OF THE PRESSURE ON Al-Si ALLOYS

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ABSTRACT

The aim of this communication is to study the effect of the high hydrostatic pressure on the phase diagram of an AS12UN commercial alloy by DTA. The high pressure range is 0-360 MPa. Microphotographies of the recovered samples are compared with samples produced by dynamic high pressure in a die-casting set in a 4000 T press on a industrial plant.

RESUME

Le but de cette communication est d'étudier par ATD l'effet de la haute pression hydrostatique sur le diagramme de phase d'un alliage AS12UN commercial. La gamme des hautes pressions est de 0-360 MPa. Les microphotographies des échantillons obtenus sont comparées à celle d'échantillons réalisés par haute pression dynamique dans une presse de 4000 T sur un site industriel.

EXPERIMENTAL METHOD

The chemical composition in Si of the AS12UN alloy is 11.8 to 12.3 w %. The high pressure vessel and the crucible are of classical type. DTA measurements are performed with two Nisil-Nicrosil thermocouples welded in opposition. The temperature is measured in the center of the sample with a Nisil-Nicrosil thermocouple. The accuracy of the measured temperatures is ± 1°C. Pressures are measured with a Bourdon manometer (HEISE 0-500 MPa, 10^{-3} f.s).

Four cycles up and down were usually made both to test the reproducibility of the results and the change in the behaviour of the alloy during the melting and the freezing under pressure.

RESULTS AND DISCUSSION

The effect of the pressure is reported in Figure 1. Experimental results in the three regions (indicated in Fig. 1) are fitted with a linear function below and above 50 MPa :

eutectic $T(°C) = 569 + 3.5\ 10^{-4}P(MPa)$

liquidus (P<50 MPa) $T(°C) = 575 - 5.7\ 10^{-4}P(MPa)$

liquidus (P>50 MPa) $T(°C) = 568 + 6.8\ 10^{-4}P(MPa)$

$\Delta T = \pm 1°C$.

From the melting curve of Al (A9) and the previous results, the behaviour of the eutectic composition have been calculated :

$$C(w\ \%) = 12 + 3.7\ 10^{-5}P(MPa)$$

the value of 13.5 (w %) obtained for the eutectic composition at 400 MPa is in good agreement with the reported values [1,2,3].
Figure 3 shows the change in the phase diagram in the pressure range 0-400 MPa taking into account in the limit of the solid solution related to :

$$C(w\ \%) = 1.9 + 7.45\ 10^{-5}P(MPa)$$

It is important to notice that the composition of the limit of the solid solution (α phase) changes faster than the eutectic composition with the increasing pressure.

The analyse of the samples has been limited to the observation of microphotographies :

(i) in comparing samples obtained under the same pressure by hydrostatic and dynamic ways.

(ii) by looking for the change in the texture caused by the pressure and the possible consequences to the mechanical properties.

CONCLUSION

From the viewpoint of the thermodynamics, the alloy appears to behave more hypereutectic when the pressure increases. From the viewpoint of the microstructure and texture, samples appear different when the pressure is applied hydrostatically or dynamically way.

1. A.I. Kingon and J.B. Clark, High Temperature-High Pressure, 16, 137 (1984).
2. D.B. Chernov and A.Y. Shinyaev, Strukt. Faxavye Prevrashch. Diagr. Sostoyaniya Met., 80-84 (1974).
3. H. Mii, M. Senoo and I. Fujishiro, Jpn. J. Appl. Phys., 15, 777 (1976).

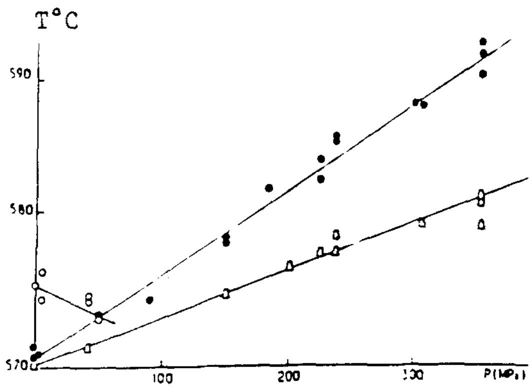

Fig. 1 : Change of the temperature v.s. the pressure of the liquidus (O , ●) and the eutectic (Δ).

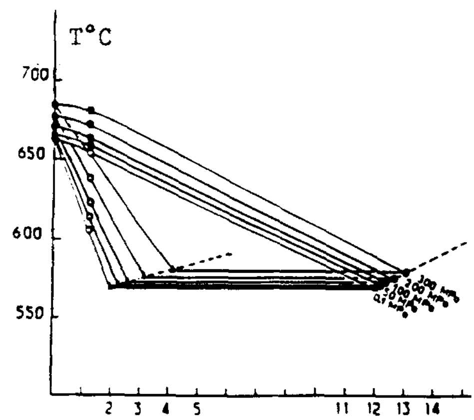

Fig. 2 : Change of the phase diagram v.s. the pressure in the range 0-300 MPa.