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Letter

The isothermal section of the Cu-rich Cu–Be–Co ternary system at 500 °C

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Abstract

The 500 °C isothermal section of the phase diagram of the Cu–Be–Co (Be and Co ⩽ 50 at.%) ternary system was investigated by X-ray powder diffraction. The isothermal section consists of three single-phase regions, four two-phase regions and two-three-phase regions. The maximum solubility of Co in α-Cu is about 1.95 at.%.

1. Introduction

The Cu–Be–Co alloy materials were used widely as current and signal carrying springs, switch blades, contacts, etc. [1, 2], plastic injection mold [3], while the contents of the main alloy elements in these copper based materials are about 0.15–3.0 wt.% Be, 0.15–0.50 wt.% Co. To obtain good mechanical properties, these kinds of materials are usually carried by solution annealing and aging before they are used. The availability of Cu–Be–Co phase diagram data would be helpful for finding the right temperature for solution annealing and aging.

The Cu–Co phase diagram was investigated in ref. 4. There is no compound in this binary system at 500 °C. The solubility of Co in Cu is less than 0.13 at.% Co [5]. The phase diagram of Cu–Be was reported in the ref. 6; two compounds CuBe and $CuBe_2$ were found. The phase diagram of Co–Be was reported in the ref. 7; only one Be–Co compound was found, having a beryllium concentration of 50 at.% or less. No data in the literature regarding the ternary equilibrium diagram Cu–Be–Co were found. In the present investigation, the phase diagram of the ternary system Cu–Be–Co (Be and Co ⩽ 50 at.%) has been determined.

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2. Experimental details

The alloys were prepared from high purity metals (copper: 99.99%; cobalt: 99.99%) and Be–Cu intermediate alloy (Be: 4.01%; Cu:95.81%). Alloy pellets were prepared by induction melting the appropriate metals in alumina crucibles in pure argon. Weight losses after melting were insignificant (less than 0.5%).

All alloys were homogenized at 700 °C for 40 days in vacuum and cooled at a rate of 10 °C h^{-1} to 500 °C. They were kept for 5 days at 500 °C and then quenched in ice water. Samples for X-ray diffraction analysis were powdered and annealed at 500 °C for 5 days in small evacuated glass tubes and then quenched into liquid nitrogen. The X-ray analysis was performed by using a Rigaku (3015) X-ray diffractometer with Co Kα radiation and iron filters.

3. Results and discussion

3.1. Phase diagram

By comparing and analysing the X-ray diffraction patterns of each sample and identifying the phases in each sample, the isothermal section of the phase diagram of the Cu–Be–Co (Be and Co ⩽ 50 at.%) ternary system was determined at 500 °C. It is shown in Fig. 1 that this section consists of three single-phase regions (α–Cu, BeCo, CuBe); four two-phase regions (α–Cu + Co, α–Cu + BeCo, α–Cu + CuBe, BeCo + CuBe) and two three-phase regions (α–Cu + CuBe + BeCo, α–Cu + BeCo + Co).

3.2. Solid solubility

The maximum solubility of Co in α–Cu is about 1.95 at.% Co (500 °C) by using the vanishing-phase method. The results obtained are basically in agreement with the data obtained by using the lattice-parameter method.

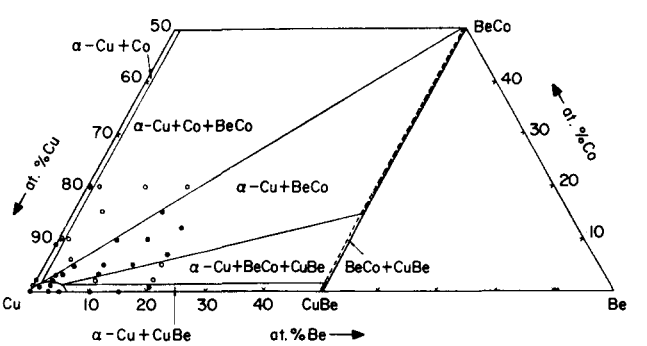

Fig. 1. Phase diagram of the Cu–Be–Co (Be and Co ⩽ 50 at.%) ternary system at 500 °C. (●) Single-phase region; (◒) two-phase region; (○) three-phase region.

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The maximum solubility of Be in α–Cu determined in refs. 6 and 8 at 500 °C is about 6.6 and 7.0 at.% respectively.

From the trend of the phase boundary of the three-phase region α–Cu + CuBe + BeCo and the two-phase region α–Cu + CuBe, it was found that the compound of BeCo has an extended range of solid solubility, the maximum solubility of Cu in BeCo being about 35.0 at.% Cu at 500 °C. The single-phase region of BeCo extends parallel to the Cu–Co line.

Acknowledgment

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References

1 Copper and Copper Alloy Mills (in England), Copper Alloy Nos. C17400 & C17410, *Alloy Digest*, Alloy Digest Inc., Orange, NJ, 1990.
2 S.L. Hoyt, *Metal Data*, Columbus, OH, 1952, pp. 402–403.
3 Brush Wellman Inc. (in America), Brush Wellman Alloy 275C, *Alloy Digest*, Alloy Digest Inc., Orange, NJ, 1988.
4 U. Hashimoto, *Nippon Kinzoku Gakkai-Shi, 1* (1937) 19–26.
5 E. Hidebrand, *Ann. Physik, 30* (1937) 593–608.
6 M. Hansen, *Constitution Binary Alloys*, McGraw-Hill Book Company, New York, 1958, pp. 281–284.
7 H. Okamoto, L.E. Tanner and T. Nishizawa, *Bull. Alloy Phase Diag., 9* (1988) 552–562.
8 Ou Xiangli, Fang Xin and Zhuang Yinghong, *Z. Metallkd.*, submitted for publication.