

國立清華大學 命題紙

98 學年度 工程與系統科學系 (所) 甲 組碩士班入學考試

科目 物理冶金 科目代碼 2601 共 3 頁第 1 頁 *請在【答案卷卡】內作答

1. (a) Determine the weight percent of metals A, B, and C for a ternary alloy ABC at point X, and Y on the ternary phase diagram grid shown in Fig. 1.

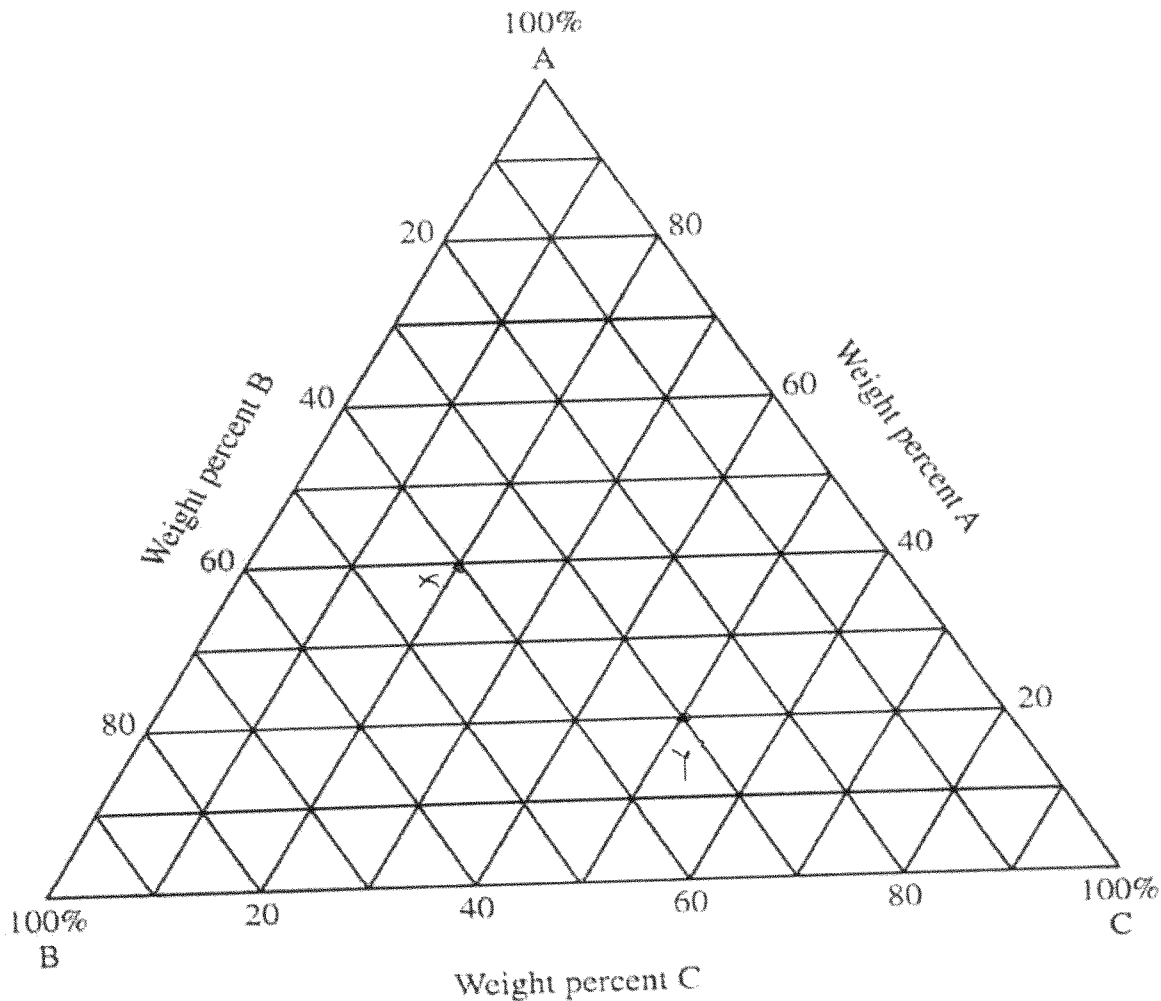


Fig.1 Ternary phase diagram composition base for an ABC alloy.

- (b) Binary equilibrium phase diagrams for components that are completely soluble in each other in the solid state can be constructed from a series of liquid-solid cooling curves. Describe the method with the aid of drawing figure to illustrate the process. (20%)
2. (a) Describe and illustrate the solidification process of a pure metal in terms of the nucleation and growth of crystals.
- (b) In the welding process, two components are joined by filling space between the two with molten metal. Explain how this process works from a solidification point of view. What are some factors are crucial in having a strong welded joint? (20%)

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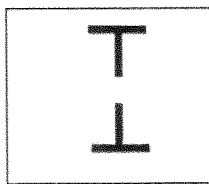
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3. An edge dislocation dipole looks like this:



(a) Give a simple physical reason why this configuration is of lower energy than other competing configurations like these:



It may help to draw a picture or two...

(b) Despite being of opposite sign, these edge dislocations do not annihilate. Explain why not.

(c) Explain why this dipole is unstable if the dislocations are screw-type instead of edge-type. (20%)

4. A diffusion couple was formed between pure copper and a copper-nickel alloy. After heating the couple to 1273 K for 30 days, the concentration of nickel in the copper is 10.0 wt% at a position of 0.50mm from the initial copper-alloy interface. What is the original composition of the copper-nickel alloy? The preexponential and activation energy for the diffusion of Ni in Cu are $2.7 \times 10^{-4} \text{ m}^2/\text{s}$ and 236,000 J/mol, respectively. $R = 8.31 \text{ J/mol-K}$ (20%)

Table Tabulation of Error Function Values

Z	erf(Z)	Z	erf(Z)	Z	erf(Z)
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

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5. In Cu-Zn alloys, both UTS and elongation are increased with increasing Zn content (at least for 0 to 35 wt%; where the alloys are single phase FCC). Explain the mechanisms in detail. From the case in Cu-Zn alloys, can you generalize a principle for increasing both UTS and elongation? Discuss your method. (20%)