

科目：材料科學導論 適用：應光系

編號：504

考生注意：  
 1. 依次序作答，只要標明題號，不必抄題。  
 2. 答案必須寫在答案卷上，否則不予計分。  
 3. 限用藍、黑色筆作答；試題須隨卷繳回。

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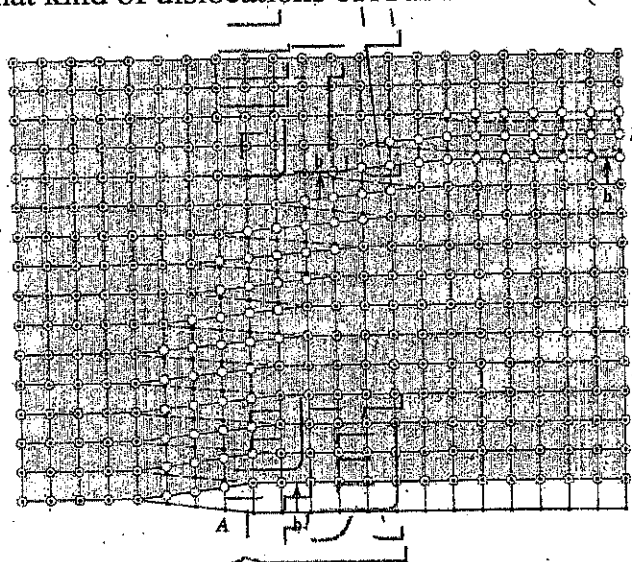
1. If boron is diffused into a thick slice of silicon with no previous boron in it at a temperature of  $1100^{\circ}\text{C}$  for 5 h, what is the depth below the surface at which the concentration is  $10^{17}$  atoms/cm<sup>3</sup> if the surface concentration is  $10^{18}$  atoms/cm<sup>3</sup>?  $D = 4 \times 10^{-13}$  m<sup>2</sup>/s for boron diffusing in silicon at  $1100^{\circ}\text{C}$ . (15%)

Table of the error function

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

2. Mixed dislocations are in one material as shown in the following figure.

Please indicate what kind of dislocations of A and B. (10%)



3. Atoms may assemble into crystalline or amorphous structures. What is the difference between two structures? (10%)

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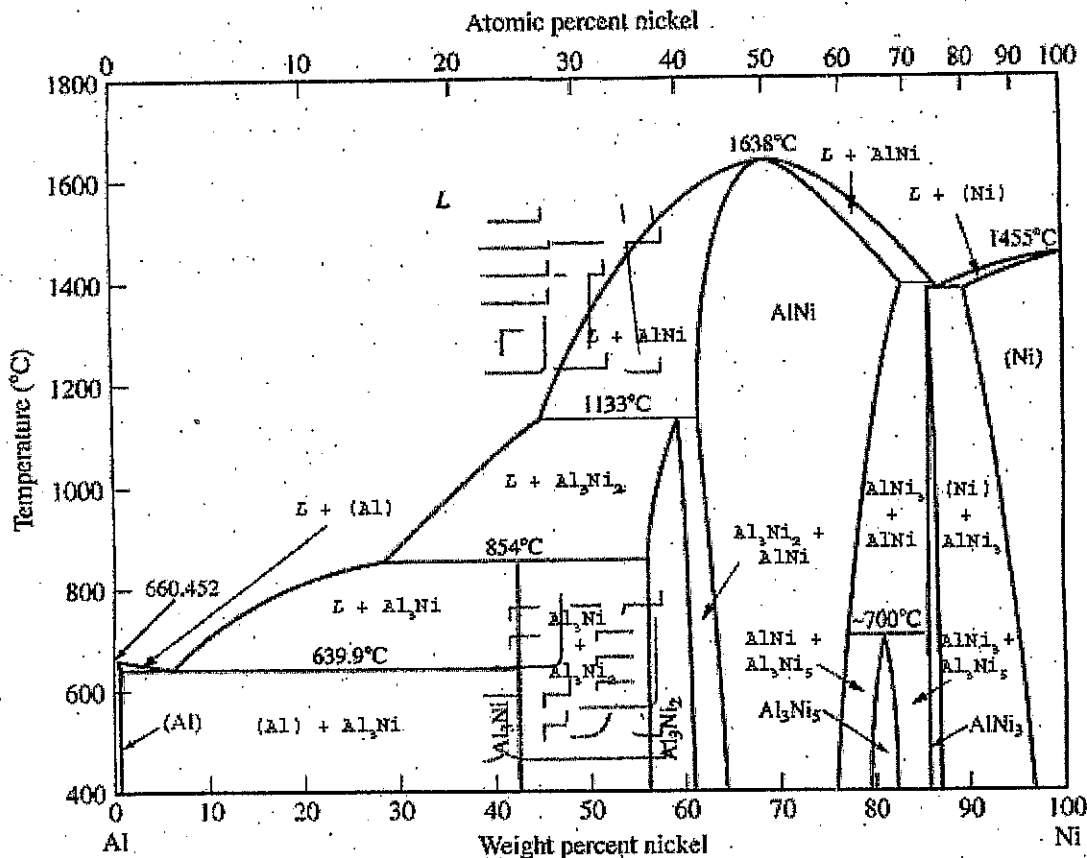
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4. The figure shows the aluminum-nickel (Al-Ni) phase diagram. Make phase analyses of 59 wt% Ni-41 wt% Al at the temperature of  $1133^{\circ}\text{C} - \Delta T$ . In the phase analyses, include:

- (a) The phases present.
- (b) The chemical compositions (weight percent of Al) of the phases.
- (c) The amounts (weight percent) of each phase.
- (d) Name the type of invariant reaction that takes place at  $1133^{\circ}\text{C}$ .

((a) 5%, (b) 5%, (c) 5%, (d) 5%)



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5. Slip is favored on close-packed planes. Why? (10%)

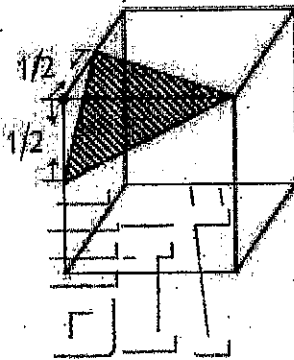
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6. What conditions for a ductile material behaves in a brittle manner? (15%)

7. A sample exhibits the plane shown in the following unit cell. (a) What is the Miller index for the plane shown in the following unit cell? (b) The interplanar spacing in this sample is 0.1204 nm. Calculate the lattice constant for this sample.

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((a) 6%, (b) 6%)



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8. Please explain elastic and plastic deformation. (8%)

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