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31039

Examen 2014-2015 _ord.pdf

Examenes Materiales Aeroespaciales I - Aerospace Materials exams I

2° Materiales Aeroespaciales I

Grado en Ingeniería Aeroespacial

Escuela Politécnica Superior
Universidad Carlos III de Madrid



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Universidad Carlos III de Madrid

EXAM

January 2015

Aerospace Materials I (2nd Year)

Surname: **Name:** **Group:**

Information:

- Read the questions carefully before answering. Use the space given for answering each question.
- You have 2h 30min to complete the exam.
- The marks assigned to each of the questions are given at the beginning of the question.
- To pass the exam you need a minimum mark of 4 over 10.

1. (2 marks) In the figure, two crystallographic planes are represented. They correspond to a cubic unit cell of a ceramic material with the following formula A_xB_y that has density of 5.92 gr/cm^3.

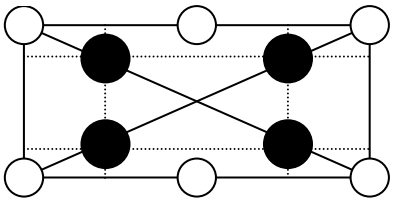
a) Determine and describe the type of structure and indicate its stoichiometry. What is the coordination index (C.I) for the ion A?
b) Determine the lattice parameter of the unit cell and the molecular weight of ion B
c) Determine the radius of ion B and calculate the packing factor
d) Calculate the linear density in the direction [111]

DATA: r(A^{m+})=0.086 nm; M(A)=91.224 g/mol ; N_A=6.023x10^{23} mol^{-1}

Ion A: ○

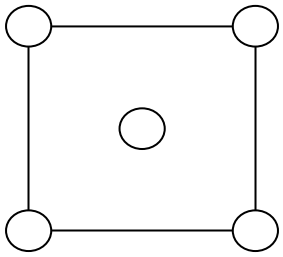
Ion B: ●

(110)/($\bar{1}\,\bar{1}\,0$)



0.731 nm

(010)



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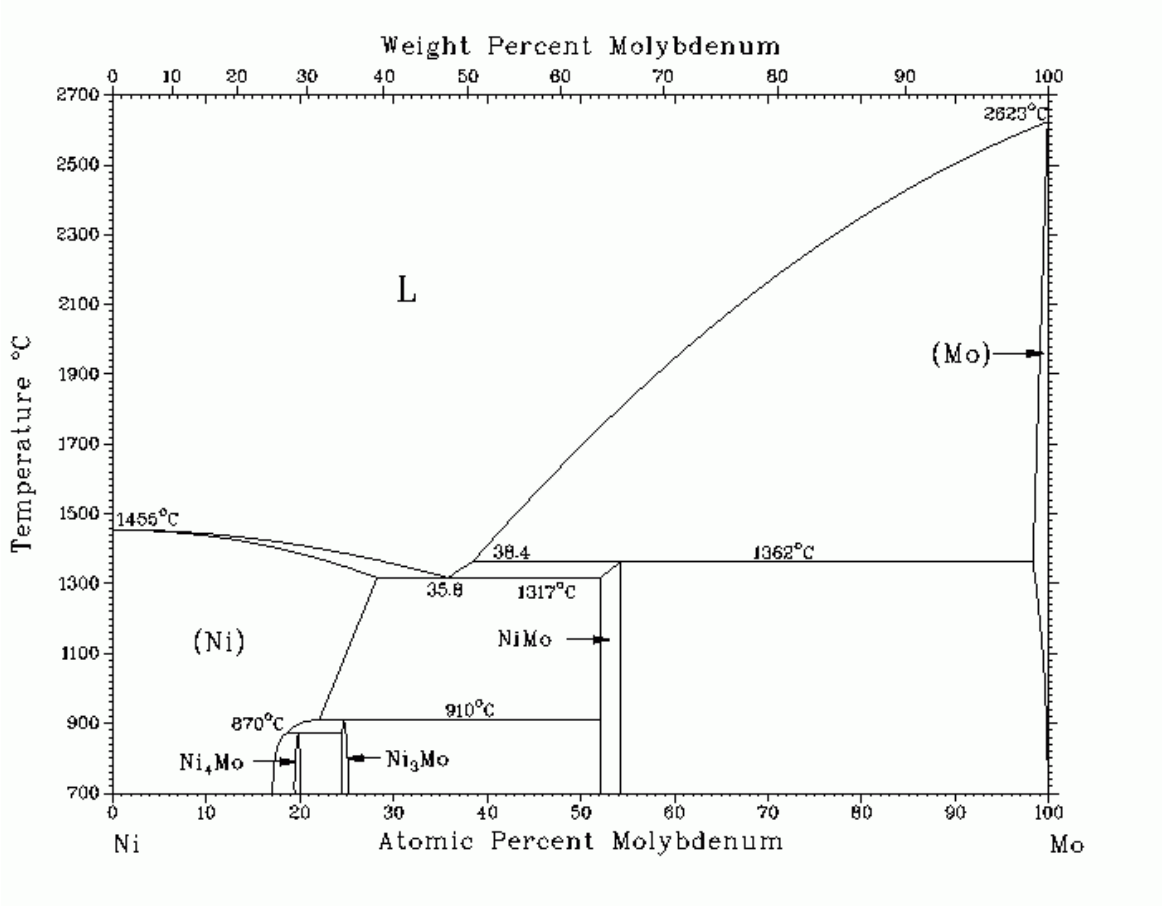
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2. (2 marks) Use the following phase diagram to answer the questions.



a) **(0.8 marks)** Mark as true (T) or false (F) the following statements

	NiMo melts congruently
	NiMo is an intermetallic compound
	At 870ºC the reaction of Ni-20at%Mo alloy is eutectoid
	At 1362ºC the reaction of Ni-54at%Mo alloy is eutectic
	Maximum solubility of Mo in (Ni) is about 28at%
	Maximum solubility of Ni in (Mo) is 15at%
	The microconstituents of Ni-60at%Mo alloy at 1300ºC, are proeutectic (Mo), and eutectic ((Mo)+ NiMo)
	At 910ºC the reaction of Ni-25at%Mo alloy is peritectoid

b) **(0.8 marks)** Determine the quantity and composition of the phases present and the quantity of the microconstituents present for a Ni-34at%Mo alloy at: (i) 1318ºC and (ii) 1316ºC

c) **(0.4 marks)** Draw in the square provided a schematic sketch of the microstructure at a temperature of 1316ºC for a Ni-34at%Mo alloy

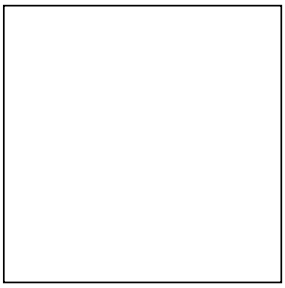
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3. **a) (0.5 marks)** How does the amount of crystallinity in a thermoplastic affect (i) its density, (ii) its tensile strength and (iii) its melting temperature? Explain briefly.

   b) (0.5 marks) Describe briefly the main differences between thermosetting and thermoplastic polymers with respect to (i) structure and (ii) temperature stability.

4. **(1 mark)** Answer the following questions and explain briefly:
   a) What is GLARE? Describe its components.
   b) In what applications it is used?
   c) What material does it substitute? What are its main advantages?

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5. **(1 mark)** Two FCC-type crystalline structures are given. Both of them have defects characterized by an extra plane of atoms. In one of these structures, the extra plane of atoms is parallel to plane (110) and in the other one is parallel to plane (100). Determine and justify: The type of defect in each structure, direction of Burger´s vector and the magnitude as a function of atomic radius. In which structure is slipping easier? (Consider the same atomic radius for both structures).

6. **a) (0.5 marks)** Explain briefly the difference between prepolymerized and polymerizing adhesives and give an example of each. Which of the two types is high resistance adhesive?

b) (0.5 marks) What are the main types of charge carriers in the following:

i. Intrinsic semiconductors
ii. p-type extrinsic semiconductors
iii. n-type extrinsic semiconductors

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7. **(1 mark)** Which factors affect the diffusivity of a material? How?

8. Answer the following questions:

a) **(0.3 marks)** Draw the stress-strain curve of an Al alloy with the yield strength σ_Y=210MPa, the ultimative tensile strength of σ_{UTS}=250MPa and a fracture stress of σ_f=160MPa at %EL=4%.

b) **(0.3 marks)** Briefly describe the main difference between elastic and plastic deformation macroscopically and microscopically.

c) **(0.4 marks)** The Al material given above will be used for a tube-shaped retainer. The inner diameter has to be 10mm. For the application a safety factor of n=2 is given. The static load is F=12000N. Calculate the outer diameter of the retainer.

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