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NPTEL

## Unit 5 - Week 4

### Assignment 4

1) A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a **1 point** decarburizing (carbon-deficient) atmosphere on the other side at 700°C ( ). If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 5 and 10 mm (  $5 \times 10^{-3}$  and  $10^{-2}$  ) beneath the carburizing surface are 1.2 and 0.8 kg/m<sup>3</sup> , respectively. Assume a diffusion coefficient of  $3 \times 10^{-11}$  m<sup>2</sup>/s at this temperature.

- 3.4x10<sup>-9</sup> kg/m<sup>2</sup>/s
- 2.4x10<sup>-9</sup> kg/m<sup>2</sup>/s
- 5x10<sup>-9</sup> kg/m<sup>2</sup>/s
- 1.2x10<sup>-9</sup> kg/m<sup>2</sup>/s

**Accepted Answers:**

*2.4x10<sup>-9</sup> kg/m<sup>2</sup>/s*

2) Which one is odd one out? **1 point**

- The free surface of a crystal
- Solidus and liquidus line
- Grain boundaries
- Interphase interfaces
- None of them

**Accepted Answers:**

*Solidus and liquidus line*

3) For the case of liquid which one is correct? **1 point**

- Surface tension is lower than surface energy
- Surface tension is higher than surface energy
- Surface tension is equal to surface energy
- No relation between surface tension and surface energy

**Accepted Answers:**

*Surface tension is equal to surface energy*

4) What is the correct order of increasing density of atoms in the planes for FCC metals **1 point**

- {220}<{200}<{111}
- {111}<{200}<{220}
- {200}<{111}<{220}
- {220}<{111}<{200}

**Accepted Answers:***{220}<{200}<{111}*

5) The number of broken bonds at the surface will increase through the series

**1 point**

- {220}<{200}<{111}
- {111}<{200}<{220}
- {200}<{111}<{220}
- {220}<{111}<{200}

**Accepted Answers:***{111}<{200}<{220}*6) When misorientation angle between two grains exceeds beyond 15 degrees, the dislocation spacing become \_\_\_\_\_ . **1 point**

- small
- large
- remains constant
- not related

**Accepted Answers:***small*7) Misorientation angle of \_\_\_\_\_ degrees corresponds to twins in FCC materials. **1 point**

- 90
- 30
- 60
- 45
- 15

**Accepted Answers:***60*8) Energy of coherent twin boundary is approx \_\_\_\_\_ mJ/m<sup>2</sup>. **1 point**

- 10
- 30
- 100
- 1
- 50

**Accepted Answers:***1*9) Metal with the high melting temperature have (\*Ls- heat of sublimation) **1 point**

- High value of Ls and low value of surface energies

- Low value of  $\gamma_s$  and high value of surface energies
- High value of  $\gamma_s$  and high value of surface energies
- Low value of  $\gamma_s$  and low value of surface energies

**Accepted Answers:**

*High value of  $\gamma_s$  and high value of surface energies*

10) Energy of twin boundary is very sensitive to \_\_\_\_\_ .

**1 point**

- solute concentration
- orientation
- defect concentration
- none of these

**Accepted Answers:**

*orientation*

11) Coherent and incoherent interface have interfacial energy of approx \_\_\_\_\_ and \_\_\_\_\_ mJ/m<sup>2</sup> respectively.

**1 point**

- 400, 500
- 600, 100
- 200, 1000
- 1000, 200

**Accepted Answers:**

*200, 1000*

12) Coherency strains are found in \_\_\_\_\_ interface.

**1 point**

- coherent
- semicoherent
- incoherent
- none of these

**Accepted Answers:**

*coherent*

13) A tilt boundary occurs when the axis of rotation is

**1 point**

- Perpendicular to boundary plane
- Parallel to boundary plane
- Mixed boundary plane
- None on them

**Accepted Answers:**

*Parallel to boundary plane*

14) Why the surface energy increases at a decreasing rate after 10-15 degree in the variation of grain boundary energy and misorientation? **1 point**

- as misorientation decrease the strain fields of the dislocations progressively add up
- as misorientation decreases the strain fields of the dislocations progressively cancel out
- as misorientation increases the strain fields of the dislocations progressively add up

- as misorientation increases the strain fields of the dislocations progressively cancel out

**Accepted Answers:**

*as misorientation increases the strain fields of the dislocations progressively cancel out*

15) Which one contains maximum boundary free energy?

**1 point**

- Coherent interface  
 Incoherent interface  
 Semi-coherent interface  
 Twin Boundary

**Accepted Answers:**

*Incoherent interface*