

MINOR TEST

PYL116 ELEMENTS OF MATERIALS PROCESSING

Dated: 8th Nov 2020

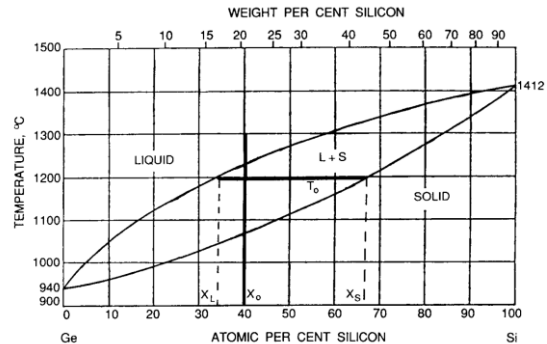
Answer all questions

Time One Hour

Maximum Marks 40

Question-1

- For the Si-Ge Phase diagram in the side figure, consider 40 at % Si. At temperatures of 1300, and 1100°C, what phases are present? What are their chemical compositions? How much of each phase is physically present? (1+2+2)
- Assume that the cluster in the capillarity theory of heterogeneous nucleation is a cube with side a . Write down the total free energy change on the formation of this cluster. The film and substrate are of different materials. Calculate critical size a^* for $\gamma_{sv}=0$, $\gamma_{vf}=\gamma_{fs}$. (5)



Question-2

- Plot the behavior of the nucleation rate with temperature (qualitatively) in atomistic theory. (2)
- Consider a vacuum system filled with O_2 to a pressure of 0.66 Pa. Calculate the flux of O_2 molecules in molecules/(cm^2 -s) impinging on a surface in the chamber at 293 K. Boltzman constant is 1.38×10^{-23} J/K. (3)
- Suppose you are asked to find the pumps to be used in a chamber to achieve UHV. How many and which pumps you will recommend? (3)
- Mention the name of two entrapment pumps? (2)

Question-3

- Draw the diagram of the epitaxial film with the substrate (i) below and (ii) above the critical thickness. Assume that the lattice constant of the film is bigger than that of the substrate. (4)
- Assuming the lattice constant varies linearly with composition x for a ternary alloy, what composition of $AlSb_xAs_{1-x}$ is lattice-matched to InP? Given $a_{InP}=5.869 \text{ \AA}$, $a_{AlAs}=5.661 \text{ \AA}$ and $a_{AlSb}=6.136 \text{ \AA}$ (2)
- Plot the behavior of misfit dislocation spacing S vs. film thickness. (2)
- Plot the behavior of the absorption coefficient versus wavelength for a direct and indirect bandgap semiconductor. (2)

Question-4: Explain the following terms *briefly* using a diagram. **No text is needed.** (10)

- Evolution of microstructure (during cooling) of Lead-Tin alloy at the eutectic composition. (4)
- Edge dislocation. (2)
- A defect " V_{As} " in GaAs. (2)
- Sintering (2)