I. PHASE DIAGRAMS

Consider Figure I.1. Assume you have a known 100g of \( \text{Al}_x\text{Ga}_{1-x}\text{As} \) semiconductor sample in the chamber.

![Phase Diagram of Al\(_x\)Ga\(_{1-x}\)As](image.png)

Figure I.1: Phase Diagram of Al\(_x\)Ga\(_{1-x}\)As

A. Suppose the composition is \( \text{Al}_{0.4}\text{Ga}_{0.6}\text{As} \). What phases of the semiconductor are present at 1750\(^\circ\) C? What is the weight and composition of each phase?

B. At what temperature does solidification begin for this composition?

C. Suppose the chamber is then cooled slowly to 1400\(^\circ\) C. What phases are present? What is the weight and composition of each phase of both components?

D. Suppose instead that the semiconductor composition is unknown (\( \text{Al}_x\text{Ga}_{1-x}\text{As} \)) and you would like to determine the molar ratio during your growth process while the chamber is set at 1600\(^\circ\) C. What must your measured mass of the solid composition be in grams for the sample to be \( \text{Al}_{0.8}\text{Ga}_{0.2}\text{As} \)?
II. BAND DISCONTINUITIES

Problem 6.1.

III. MODEL SOLID THEORY

Problem 6.4.

IV. BAND DIAGRAMS

Problem 7.1. Please label all parts.

V. STRAIN

Recently, Intel demonstrated a p-channel pseudomorphic high hole mobility transistor (p-HHMT) by using a compressively strained InSb QW as the channel material. The barrier material is Al$_{0.35}$In$_{0.65}$Sb.

A. Calculate the critical thickness of the InSb QW grown on Al$_{0.35}$In$_{0.65}$Sb. Note: The Al$_{0.35}$In$_{0.65}$Sb barrier material is very thick and thus unstrained.

B. For a 5 nm InSb QW, determine the strain $\varepsilon$, $\Delta E_C$, and $\Delta E_V$. Assume no defects are generated in this heterostructure.