

Phase Diagrams

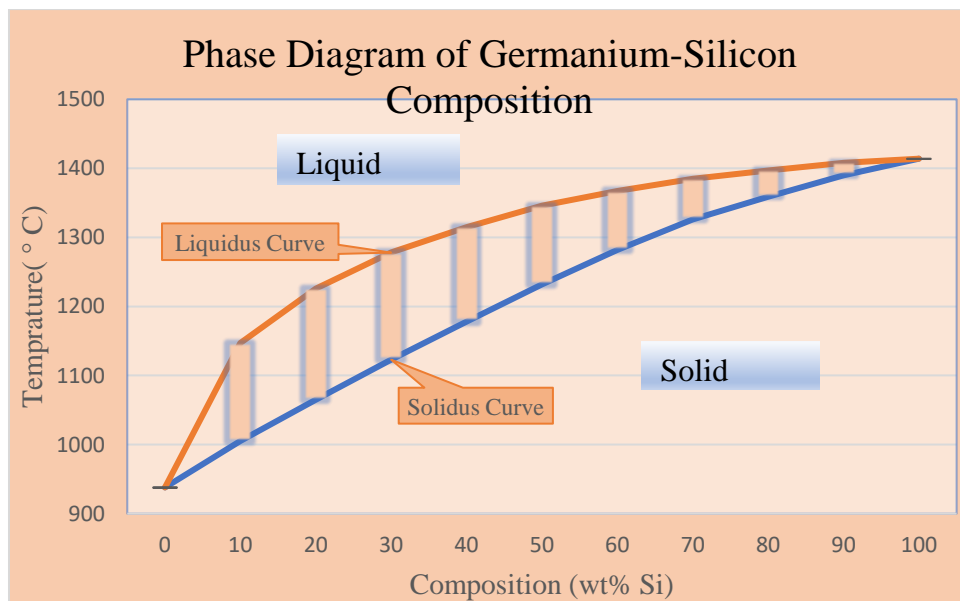
Course: IE220

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- 1) Given here are the solidus and liquidus temperatures for the germanium-silicon system. Construct the phase diagram for this system and label each axis and region (in excel, temperature axis should be between 900 °C and 1500 °C)

Composition (wt% Si)	Solidus Temperature (°C)	Liquidus Temperature (°C)
0	938	938
10	1005	1147
20	1065	1226
30	1123	1278
40	1178	1315
50	1232	1346
60	1282	1367
70	1326	1385
80	1359	1397
90	1390	1408
100	1414	1414

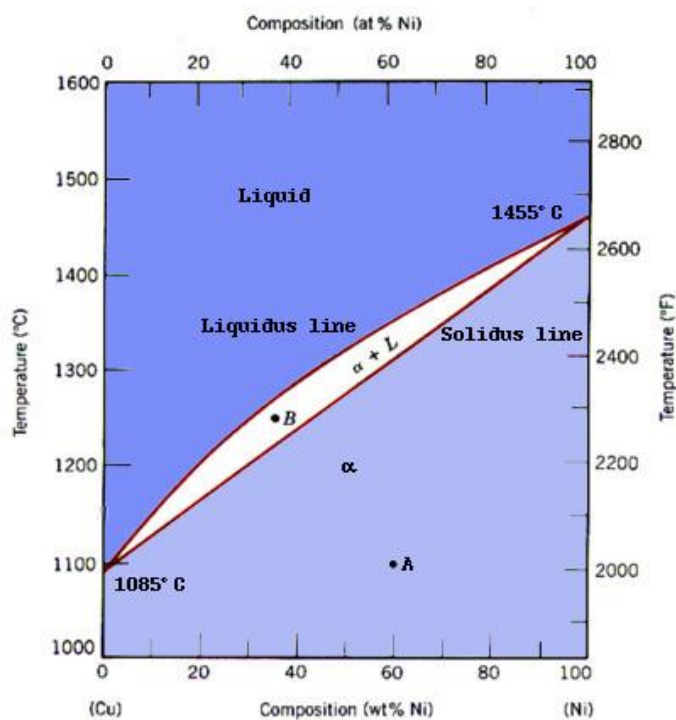


2) For germanium (Ge) – silicon (Si) system, cite the phases that are present, phase compositions and weight fractions

@ $T=1100^{\circ}\text{C}$ 20wt% Si

@ $T=1200^{\circ}\text{C}$ 70wt% Ge

Situations	Present Phases	Phase Compositions	Weight Fractions
$T=1100^{\circ}\text{C}$ 20wt% Si	Liquid&Solid	7.5%Liquid Si, 25.5%Solid Si	30.5%Liquid, 69.5%Solid
$T=1200^{\circ}\text{C}$ 70wt% Ge	Liquid&Solid	17.%Liquid Si, 43.5%Solid Si	50.9%Liquid, 49.1%Solid



3) How many kilograms of nickel must be added to 5.66 kg of copper to yield a liquidus temperature of 1200°C ?

Liquidus temperature is the T where the whole mixture melts. When we look at the phase diagram of Cu and Ni, we can use the lever rule to find percentage of weight of these two components. Weight percentage of Nickel is about 18%wt. After applying lever rule, weight of Nickel should be added is found as 1.24 kilograms.

- 4) How many kilograms of nickel must be added to 2.43 kg of copper to yield a solidus temperature of 1300 °C?

Solidus temperature is T where the whole mixture freezes. According to the phase diagram of Ni and Cu and applying the lever rule to the values of the diagram, weight percentage of Nickel is about 57%wt. And the weight of nickel should be added is found as 3.22 kilograms.

- 5) A copper-nickel alloy of composition 70 wt% Ni-30 wt% Cu is slowly heated from a temperature of 1300 °C (2370 °F).

- (a) At what temperature does the first liquid phase form?

According to phase diagram, initially the mixture is solid. When it is heated slowly, its first liquid phase form exists in about 1345 degrees of Celsius.

- (b) What is the composition of this liquid phase?

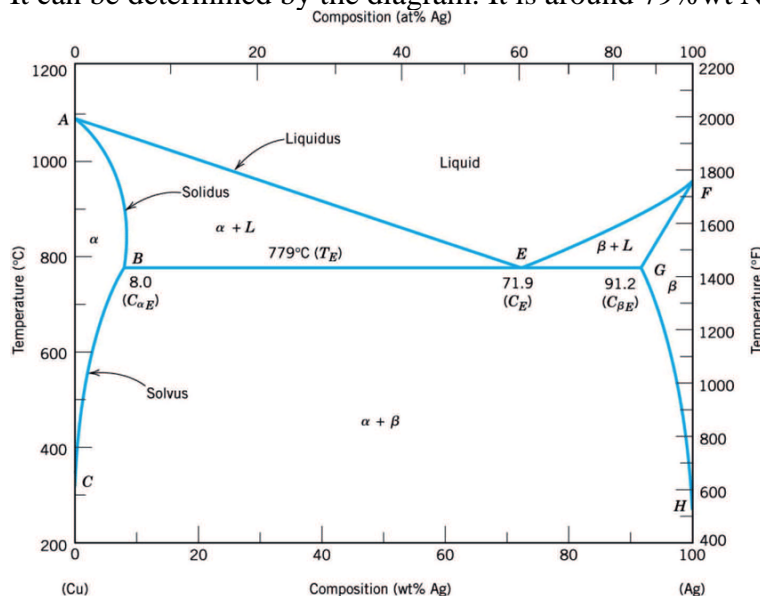
To find this 1345 degrees of Celsius liquid phase's composition, we apply lever rule. Thus, we find 1%wt of mixture is in liquid phase.

- (c) At what temperature does complete melting of the alloy occur?

According to phase diagram, liquidus curve's intersection with 70%wt line is at 1375 degrees of Celsius.

- (d) What is the composition of the last solid remaining prior to complete melting?

It can be determined by the diagram. It is around 79%wt Nickel.



- 6) At 700 °C (1290 °F), what is the maximum solubility?

- (a) of Cu in Ag?

Around 6%wt

- (b) Of Ag in Cu?

Around 5%wt

(c) what is the corresponding temperature to achieve maximum solubility limit of Cu in Ag

779°C

d) What is the maximum solubility limit of Cu in Ag in wt%

8.8%wt