MSE 360: Phase Transformation and Diffusion

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Lecture 1
Policies and Procedures
see the Syllabus for more details

• Test grading:
  – Written request for changing grade

• Missed tests
  – Makeup test in the “dead week”
  – 1 makeup test only

• Attendance
  – Attendance expected (0.2% penalty for missing a quiz)
Grading

- Reading assignment 5%
- Test 1 30%
- Test 2 30%
- Final 35% (The final is comprehensive)

<table>
<thead>
<tr>
<th>Weighted average</th>
<th>&gt;-98</th>
<th>97.9-94</th>
<th>93.9-90</th>
<th>89.9-86</th>
<th>85.9-82</th>
<th>81.9-78</th>
<th>77.9-73</th>
<th>72.9-68</th>
<th>67.9-63</th>
<th>62.9-53</th>
<th>&lt;53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter grade</td>
<td>A+</td>
<td>A</td>
<td>A-</td>
<td>B+</td>
<td>B</td>
<td>B-</td>
<td>C+</td>
<td>C</td>
<td>C-</td>
<td>D</td>
<td>F</td>
</tr>
</tbody>
</table>

No grade markup
Teaching style

• **Active student participation in class**
  
  • A dice will be rolled to determine who participates
  • 0.2% will be deducted if you are not present in the class to answer a quiz;
  • 0.2% will be given if you give the right answer
  • 0.2% will be given to a volunteer who gives the right answer
  • No credit will be given or deducted if you give a wrong answer
  • No one get called more than twice for each lecture
Reading assignment

• Each missed assignment will reduce the 5% credit by 1%.
• Quiz will be used to check if you have finished the reading assignment.
• A student will be chosen randomly using a dice to answer the quiz
• 0.2% credit for correct answer.
Quiz Coordinate

Download from

http://www.mse.ncsu.edu/research/zhu/Class-Teaching/MSE360
Phase Transformation

- Melting Ice: [http://www.youtube.com/watch?v=rElpewOvAMc](http://www.youtube.com/watch?v=rElpewOvAMc)
- Phase
- Components
- Composition
- Gibbs Phase Rule: \( P + F = C + 2 \)
Thermodynamics

Basics: \( G = H - TS \), \( H = U + PV \), \( dU = T \, dS - P \, dV \)

Equilibrium state

Metastable equilibrium

Kinetics: rate controlled process:

\[
rate = C e^{\frac{-\Delta E_a}{kT}}
\]

\[
= C e^{\frac{-\Delta E}{RT}}
\]

Department of Materials Science and Engineering
Single component systems

- G as a function of T (G=H-TS)
  - Heat capacity \( C_p = \left( \frac{\partial H}{\partial T} \right)_p \)
  - Enthalpy \( H = \int_0^T C_p dT \)
  - Entropy \( S = \int_0^T \frac{C_p}{T} dT \)

\[ dG = -SdT + VdP, \]

\[ \left( \frac{\partial G}{\partial T} \right)_p = -S = -\int_0^T \frac{C_p}{T} dT \]
Pressure effect and Driving Force for Phase transformation

\[ \left( \frac{dP}{dT} \right)_{eq} = \frac{\Delta S}{\Delta V} = \frac{\Delta H}{T_{eq} \Delta V} \]

Solidification of liquid (Fig. 1.6)

\[ \Delta G \approx \frac{L\Delta T}{T_m} \]
Home Work

• Reading assignment: Ch. 1.3
• HW: 1.1, 1.3, 1.4

• Summary of concepts:
  – Equilibrium/metastable state
  – Slope of G as function of T
  – Water freezing: volume change, why?