

MET/MSE 421: Light Metals

Course Information:

Course title: Light Metals

Course number: MET/MSE 421

Course credits: 3 credits

Instructor Information:

Instructor: Dr. F.H. (Sam) Froes

Office: McClure Hall, Room 437

Telephone: 885-7989

Fax: 885-4009

E-mail: froes@uidaho.edu

Office Hours: Open

Assigned Text: Course handouts and supplemental readings (to be announced)

Course Scope:

This course is designed to introduce junior/senior students in metallurgical engineering and materials science and engineering to the world of light metals.

Course Topics:

1. Extraction of light metals
2. Physical metallurgy
3. Aluminum
4. Magnesium
5. Titanium

Class Calendar:

| CLASS | CLASS ACTIVITY |
|-------|---|
| 1 | Introduction |
| 2 | Introduction to light metals. Shipments. Cost/Markets. |
| 3 | Extraction of light metals. Melting, special considerations. Uses. |
| 4 | Physical metallurgy review (precipitation, equilibrium in condensed systems, free energy, lever rule) |
| 5 | Common tangent rule. Equilibrium diagrams from free energy curves. Interface curvature effects. |
| 6 | Solvus. Intermediate phases. Solution treatment –quench – age. T-T-T-curves |
| 7 | Kinetics of phase transformations. Solidifications, homogeneous and heterogeneous. |
| 8 | Solid state nucleation, homogeneous/heterogeneous. Precipitation sequence |

| | |
|----|---|
| | in Al-Cu (Free energy changes versus nucleation, barrier) |
| 9 | Interfaces. Precipitate shape: energy and misfit strain effects (First homework) |
| 10 | Coherency loss. Precipitate coarsening. Precipitation hardening. |
| 11 | Precipitation in the region of grain boundaries. Precipitation kinetics (effect of vacancies). Trace element effects. |
| 12 | Theory of metallic phases. Crystal structure. Intermediate phases. Hume-Rothery Rules. |
| 13 | Binary Phase diagrams (free energy of mixing). Solubility plots (size factors and valence). |
| 14 | Review of physical metallurgy |
| 15 | ALUMINUM. Phase diagrams. Corrosion behavior. Alloy systems and designations. |
| 16 | Wrought alloys. Precipitate sequences, commercial alloys. |
| 17 | Processing. Work hardening. |
| 18 | Non-heat-treatable and heat-treatable alloys. Al-Li. |
| 19 | MID-TERM EXAM |
| 20 | Mechanical properties. Special processes/joining. Superplastic forming. |
| 21 | Aluminum casting. Designations, alloys, properties. |
| 22 | Aluminum metal matrix composites, powder metallurgy: rapid solidification and mechanical alloying. |
| 23 | Review of aluminum. |
| 24 | MAGNESIUM Introduction. Alloying behavior. Phase diagrams. Melting and casting. Grain Refinement. |
| 25 | Alloys and designations. Cast alloys. |
| 26 | Wrought alloys. Corrosion behavior. Fabrication. (Second homework). |
| 27 | Rapid solidification. Metal matrix composites. Applications (emphasis on automobile use). |
| 28 | Review of magnesium. |
| 29 | TITANIUM. Introduction. Historical perspective. Alloying. Phase diagrams. Alloy classes (alpha, alpha-beta, beta and intermetallics). |
| 30 | Beta transformations. Deformation and recrystallization. |
| 31 | Melting, casting, and powder metallurgy. |
| 32 | Processing. Joining, forming, machining. Corrosion behavior. |
| 33 | Mechanical properties of titanium alloys. Special alloys. The intermetallics (Ti_xAl , $x=1$ or 3), alloys and properties. Metal matrix Composites. |
| 34 | The titanium marketplace; Aerospace applications (engines and airframes). Non-aerospace applications. The golf club phenomena. |
| 35 | Review of Titanium. |
| 36 | FINAL EXAM |

Grading:

1. Homework

2. Exams
3. Projects

Standard University of Idaho grading and academic honesty policies will be applied.

Disability Support Services Reasonable Accommodations Statement:

Reasonable accommodations are available for students who have a documented disability. Please notify the instructor during the first week of class of any accommodation(s) needed for the course. Late notification may mean that requested accommodations might not be available. All accommodations must be approved through Disability Support Services located in the Idaho Commons Building, Room 333.

- 885-7200
- email at <dss@uidaho.edu>
- website at <www.access.uidaho.edu> or <www.webs.uidaho.edu/aap>

Grading:

There will be a mid-term and final exam. These exams will make up 60% of the total grade (30% each). Homework will carry 20% of the total grade. A class assignment involving a paper and presentation will make up the remaining 20%

Standard University of Idaho grading policy applies.