Ira A. FULTON school of engineering

School of Materials at ASU

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Outline of Presentation

- Current status of materials education at ASU
- School of Materials
- Management
- Curricula
- Student hours
- Conceptual framework of service course
- Final thought

Current Status

Undergraduate Education

- Provided by the Materials Engineering Program of the Department of Chemical and Materials Engineering
- ABET accredited
- 80 students

Graduate Education

- Provided by the Materials Engineering Program of the Department of Chemical and Materials Engineering (60 students)
- Provided by the Science and Engineering (SEM) Program of the Division of Graduate Studies, a virtual, interdisciplinary program (70 students)

School of Materials

Objective

To create a focal point for materials education at ASU

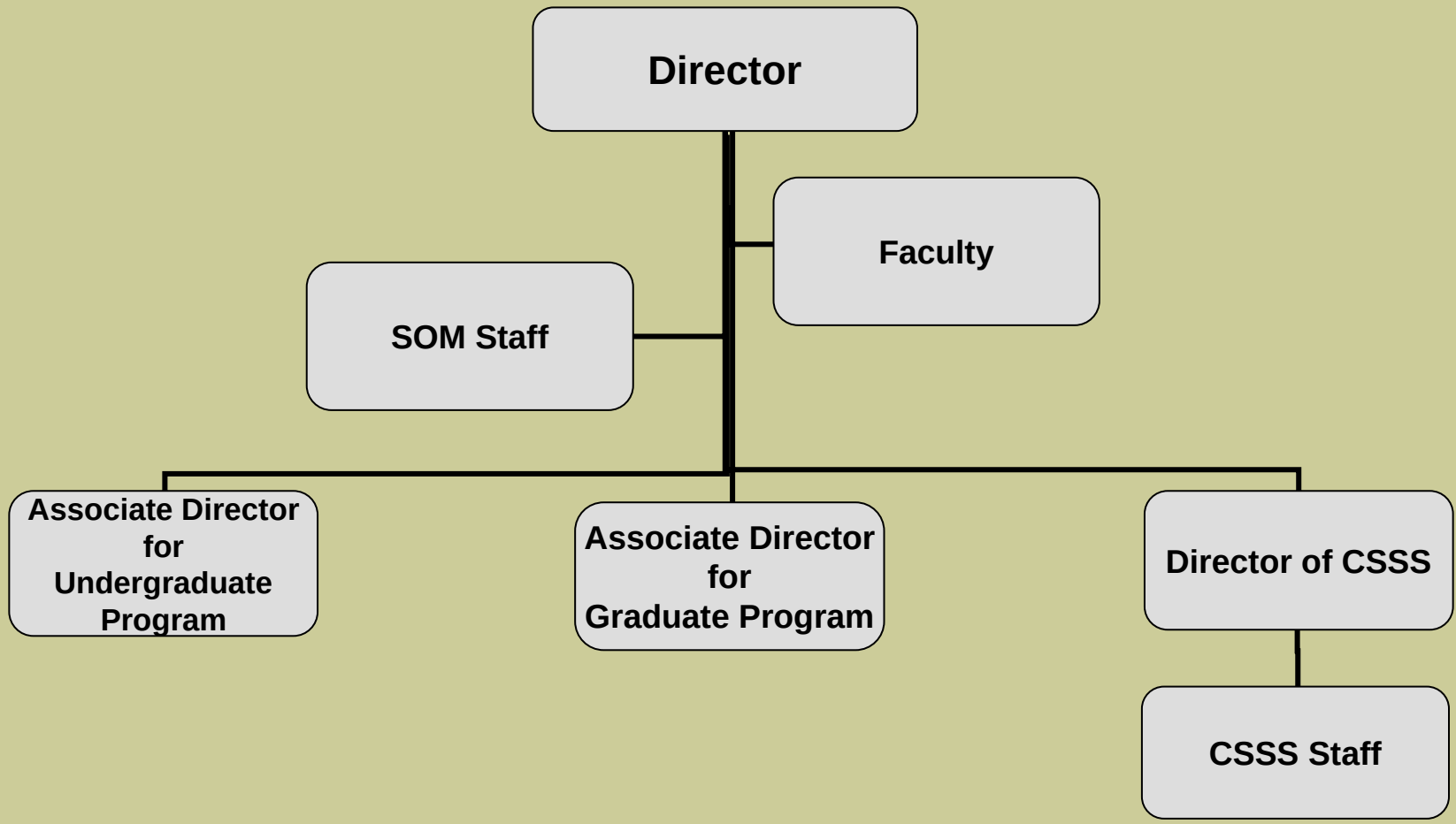
Concept and Vision

To bring together materials faculty from various disciplines to provide contemporary, integrated education in materials

School of Materials (Cont'd)

- **Components**
  - Undergraduate Program of Materials Engineering
  - Graduate Program of Materials Engineering
  - Graduate Program of SEM
  - Center for Solid State Science
  - Center for Solid State Electronics Research
- **Advantages**
  - Decent size faculty (20) plus affiliates
  - Decent size graduate student body (130)
  - Flexibility in education

Management of SOM



Curricula Highlights

Undergraduate

- 120 units
- New courses
  - Introduction of Materials Engineering
  - Introduction to Mechanics of Materials
  - Materials Synthesis
  - Mathematical and Computational Methods for Materials
  - Materials Kinetics and Processing
  - Introduction to Electronic, Magnetic and Optical Properties of Materials

Curricula Highlights (Cont'd)

Graduate

- 30 units
- Core courses
  1. Electrical, magnetic and optical properties of materials
  2. Thermodynamics
  3. Phase transformations and kinetics
  4. Structure and mechanical properties of materials
- Required course
  1. Mathematics

Student Hours

- Service teaching for engineering, physics, chemistry, geology and life sciences
- Develop materials minor and double majors

Challenges in Introductory Materials Course

- Developing a conceptual framework for educating future engineers and scientist in materials that integrates various materials types
- Delivering vast knowledge base in one semester
- Coupling of classroom teaching with laboratory work

Conceptual Framework

- Engineering materials introduced as answers to a set of six questions
- Materials blind
- Builds knowledge base in materials in one semester

Conceptual Framework (Cont'd)

Set of Questions

1. How are atoms held together in solids?
2. Do solids contain defects?
3. How do solids respond to stresses?
4. How can we make strong solids?
5. How can we store information using magnetic materials?
6. How can we transmit information using lightwaves?

Conceptual Framework (contd)

How are atoms held together in solids?

- Electronic structure of atoms and energy levels
- Changes in levels when two atoms are brought together
- Concept of band gap and differences between metals, semiconductors and insulators
- Formation of one-, two- and three- dimensional structures
- Nature of bonding
- Planes and directions

Conceptual Framework (contd)

Do solids contain defects?

- Zero, one-, two-, and three-dimensional defects in different types of materials
- Temperature dependence of concentration of zero-dimensional defects; emphasize the influence of bonding type
- Concept of dislocations, Burgers vector and their types; cover different types of materials
- Point defects and diffusion in various types of materials

Conceptual Framework (contd)

How do solids respond to stresses?

- Elastic behavior; influence of bonding type; cover different types of materials
- Movement of dislocations under stresses leading to plastic deformation; cover different types of materials
- Force acting on dislocation due to applied stress
- Strain produced by the movement of dislocations

Conceptual Framework (contd)

How can we make strong solids?

- Introduce various strengthening mechanisms; blocking motion of dislocations
- Solid solution hardening
- Precipitation hardening; introduce the concept of phase diagrams
- Dispersion strengthening
- Strengthening by interfaces; introduce the concepts of grain boundaries and martensitic transformations

Conceptual Framework (contd)

How can we store information using magnetic materials?

- Introduce magnetic materials
- Magnetization by domain wall motion
- Principles of magnetic memories and their fabrication
- Influence of microstructures on magnetic properties

Conceptual Framework (contd)

How can we transmit information using lightwaves?

- Lightwaves communication systems
- p-n junctions, light emitting devices and detectors
- Fabrication of low loss fibers
- Defects and device performance

Possible experiments

1. Solidification of Al-Cu alloys and their microstructures
2. Microstructures of polyethylene films
3. Glass transition temperature of polymers
4. Etching of dislocations in semiconductors
5. Synthesis of phosphors

Final Thought

We are creating a unique environment for materials education and research at ASU. The School will become the focal point for materials.