MSE 170: Fundamentals of Materials Science

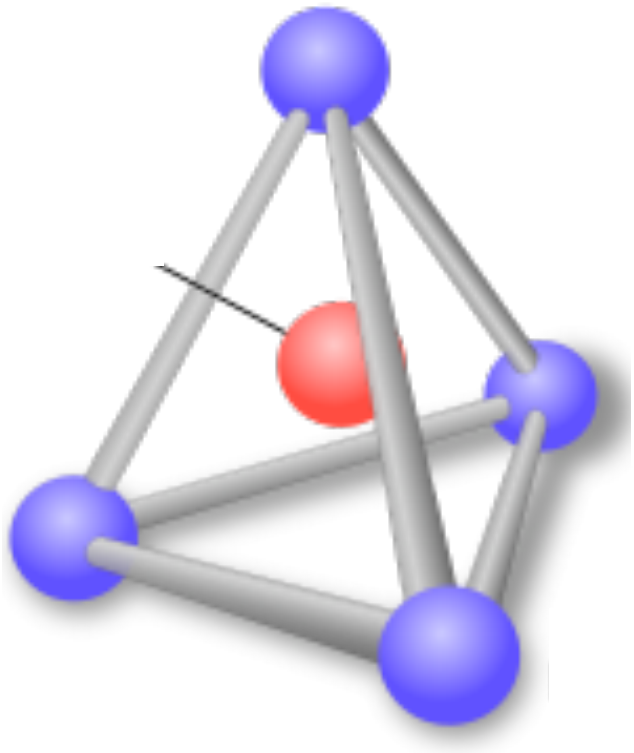
Prof. Marco Rolandi

Course Objective...

Introduce fundamental concepts in Materials Science

Questions?

What is materials Science?



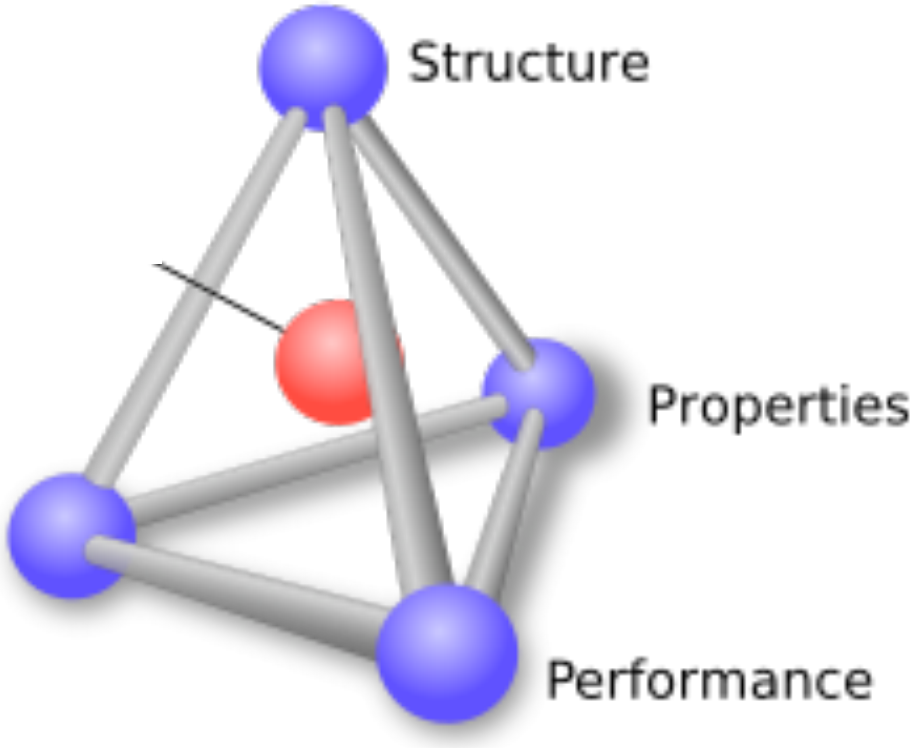
?

Cork

Lead

Reproduced from http://www.benmyers.net and webmetals.com

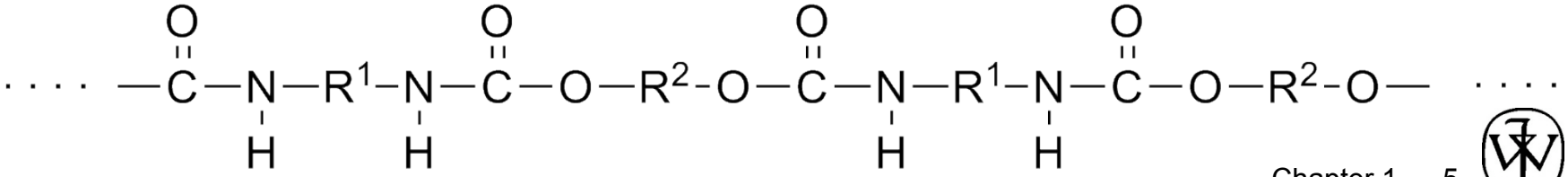
What is materials Science?



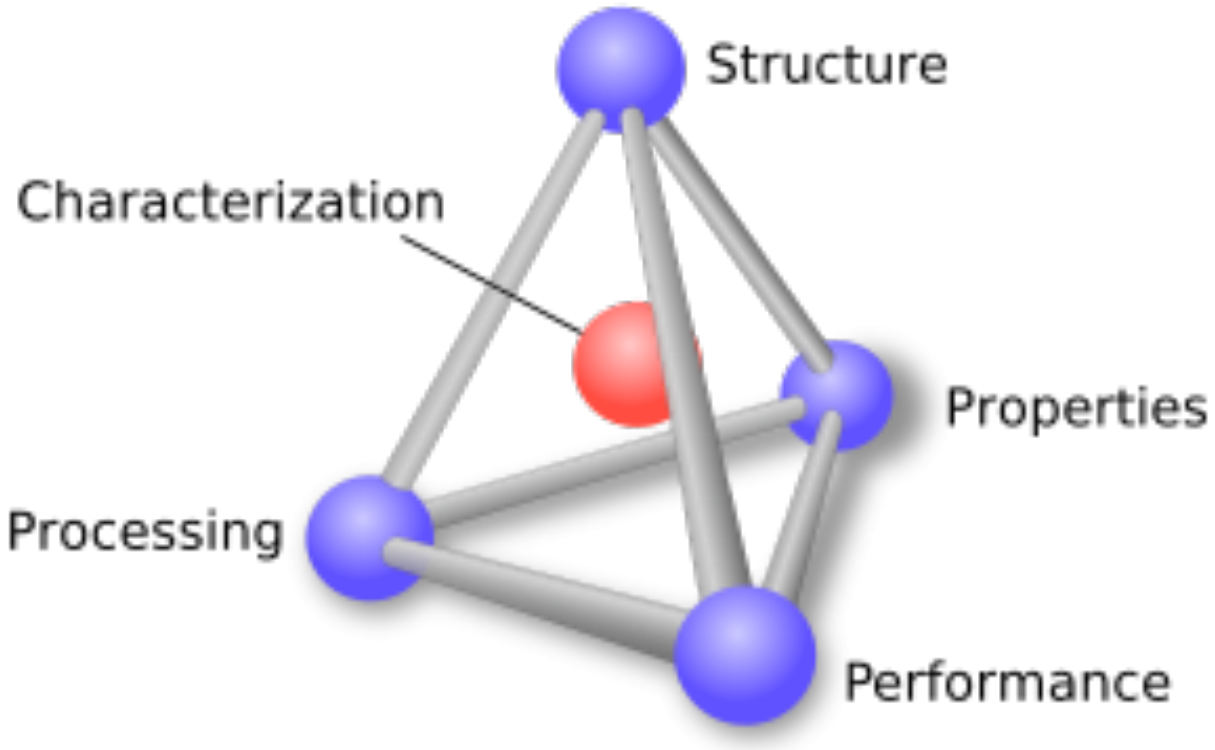
How ????? affects structure

Polyurathane foam

Dense Polyurathane



What is materials Science?



The Materials Selection Process

1. Pick Application ⟶ Determine required Properties
2. Properties ⟶ Identify candidate Material(s)

   Material: structure, composition.

3. Material ⟶ Identify required Processing

   Processing: changes *structure* and overall *shape*
   ex: casting, sintering, vapor deposition, doping
   forming, joining, annealing.

MSE 170: Fundamentals of Materials Science & Engineering

Course Objective...

Introduce fundamental concepts in Materials Science

You will learn about:

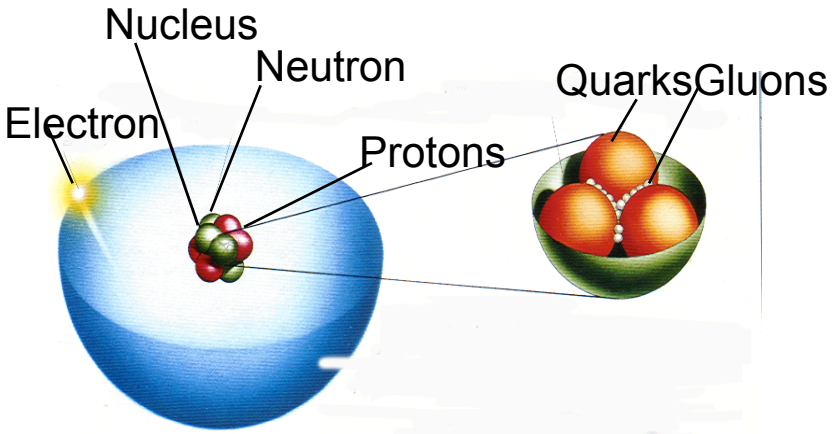
- material structure
- how structure dictates properties
- how processing can change structure

This course will help you to:

- pick your next bicycle, pair of skis, or surfboard
- design an ACL artificial replacement
- start a company that makes a synthetic kidney and become rich and famous!

Structure of Materials

- Atomic-scale structure
- Perfect crystal structure
- Imperfect crystal

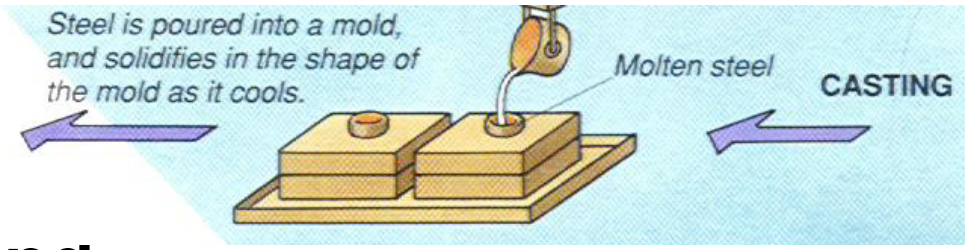


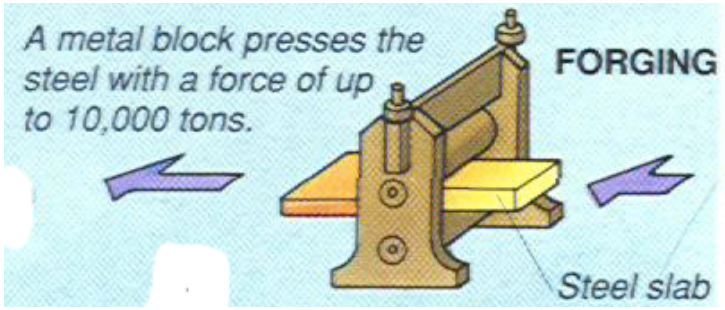
Properties of Materials

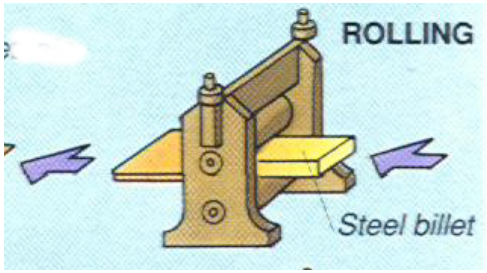
- Mechanical
- Electrical
- Magnetic
- Dielectric/optical
- Thermal
- Biocompatibility

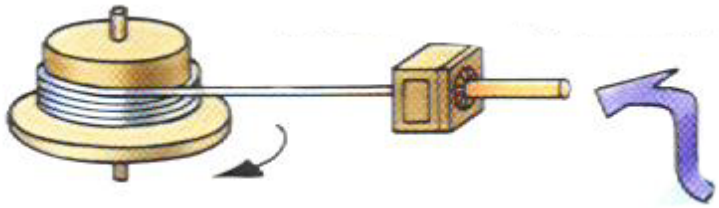
Materials Processing

- Casting
- Forming (forging, rolling, extrusion, and drawing)
- Powder processing
- Machining
- Joining









Drawing

Types of Materials

- Metals:
- ?:

Mr. McGuire: I want to say one word to you. Just one word.
Benjamin: Yes, sir.
Mr. McGuire: Are you listening?
Benjamin: Yes, I am.
Mr. McGuire:….

From “The Graduate” 1967

Types of Materials

- Metals:

  ?:

  Mr. McGuire: I want to say one word to you. Just one word.
  Benjamin: Yes, sir.
  Mr. McGuire: Are you listening?
  Benjamin: Yes, I am.
  Mr. McGuire:….**plastics**

Types of Materials

- Metals
- Polymers/plastics
- Ceramics
- Composites
- Semiconductors
- Biomaterials
- Nanoengineered Materials

Types of Materials

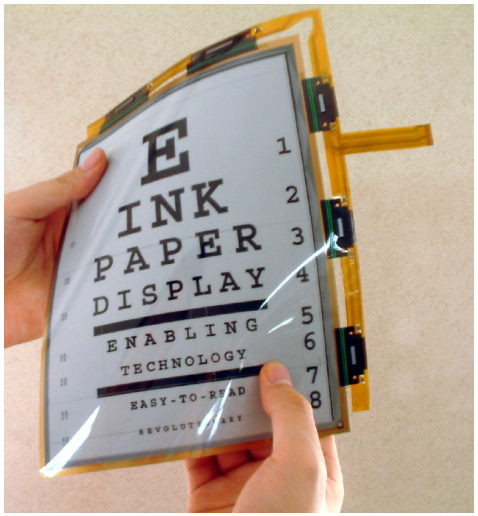
- Metals :

  Iron and Steel
  Alloys and Superalloys

  Gold, Silver, etc.

- Polymers/plastics

  Rubber
  plastics
  organic light emitting diodes
  (flexible displays)



Types of Materials

- Ceramics
  - **Structural Ceramics (high-temperature load bearing)**
  - **Refractories (corrosion-resistant, insulating)**
  - **Whitewares (e.g. porcelains)**
  - **Glass**
  - **Electrical Ceramics (capacitors, insulators, transducers, etc.)**
  - **Chemically Bonded Ceramics (e.g. cement and concrete)**

Types of Materials

- Composites

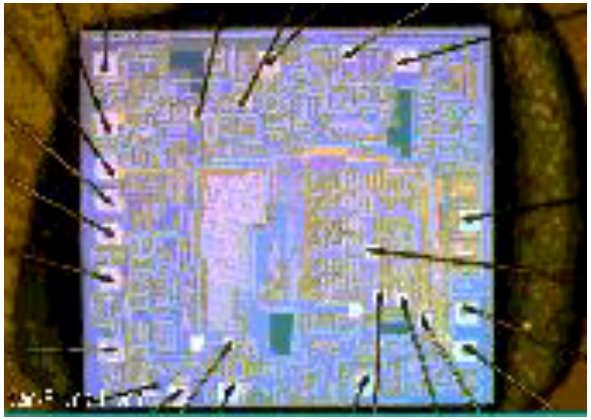
  Particulate composites (small particles embedded in a different material)

  Laminate composites (golf club shafts, tennis rackets

  Fiber reinforced composites (e.g. carbon fiber)

Advanced Materials

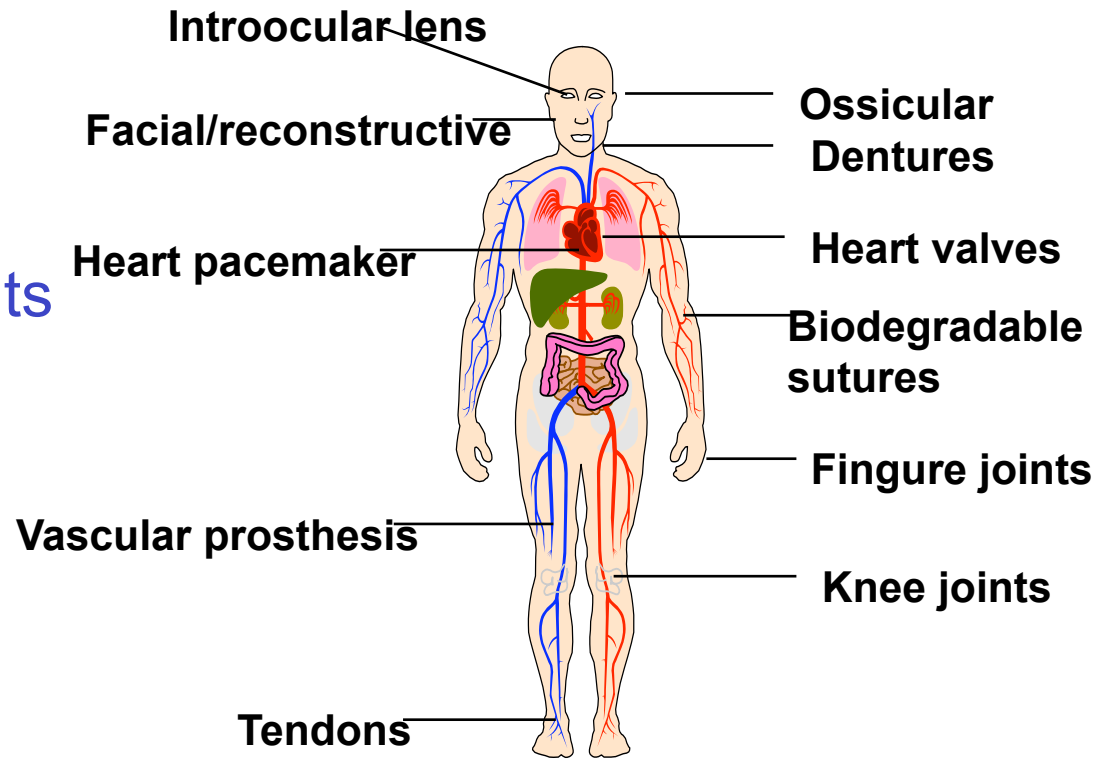
- Semiconductors
  - **Silicon and Germanium**
  - **III-V Compounds (e.g. GaAs)**
  - **Photonic materials**
  - **(solid-state lasers, LEDs)**



Advanced Materials

- **Biomaterials**

- Cardiovascular
- Ophthalmological
- Soft Tissue Implants
- Dental
- Orthopedic
- Biotechnology

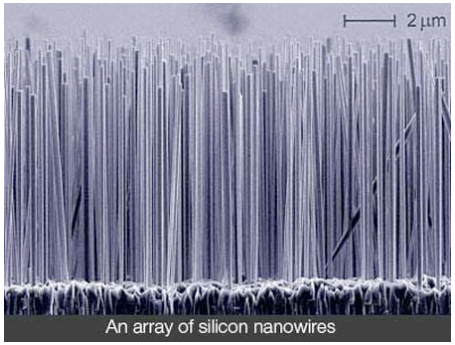


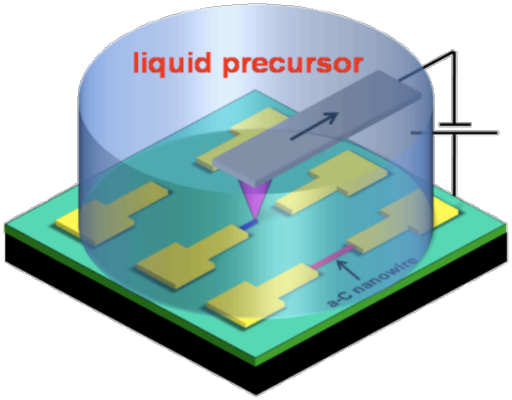
Advanced Materials

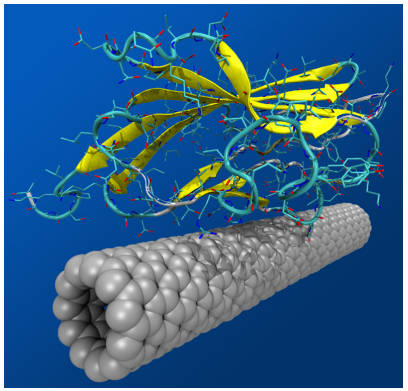
- **Nano-Engineered Materials**

(nano= 10^{-9} ~ 10 000 smaller than diameter human hair)

- Nanocrystals
- Nanotubes/nanowires
- Nanosensors







MSE 170 Fall 2008

Instructor: Prof. Marco Rolandi

rolandi@u.washington.edu

Send email with MSE 170 in the subject line-
otherwise it will not be answered

Lectures : section A 8:30-9:20am Mueller 153 MWF

Office Hours : 9:30-11 am Fri 302J Roberts

or by appointment only if you cannot make Fri due to scheduling conflicts

TAs: Lead Nik Hrabe nhrabe@u.washington.edu

Shelly Arreguin	arreguin@u.washington.edu
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MSE 170 Fall 2008

Homework: due at 5PM every Fri; the Box in Mueller 168; No late homework; drop the lowest homework grade.

Labs: dropped from the class if you do not attend first week lab; team formation; print out lab manual from web; read manual beforehand, wear safety glasses, closed shoes.

Notebooks: questions assigned by Tas.

Group project: pick an application, find an appropriate material, test material, data analysis, final presentation in front of TAs and professor.

team formation (2nd week)
project proposal (4th)
poster (10th)
project presentation (11th)

GRADING

Homework 10%

Your lowest homework grade will be dropped

Midterm 15%

Scheduled for: Oct 27th same time and location as class

Labs 15%

Lab Notebooks 5%

Team Project 25%

Final 30%

Scheduled for: December 9th

Material covered:

Everything you always wanted to know about MSE and you were afraid to ask!

COURSE WEBSITES

Course Website: http://courses.washington.edu/mse170/index.shtml

- Syllabus
- Lecture notes
- Answer keys
- Lab handouts

Text Website: http://www.wiley.com/college/callister

- Additional Chapters (Chapters 19-23)
- Complete solutions to selected problems
- Links to other web resources
- Extended learning objectives
- Self-assessment exercises