Plastics

Polymer properties

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Polymer properties

Polymers are used in a variety of applications, including

- Packaging
- Transportation
- Clothing
- Electric devices
- etc

Some of their outstanding properties are:

- High durabilily
- Low weight
- Low melting point
- Electrical insulators
- etc

Let’s briefly review some of their properties, in the context of engineering materials

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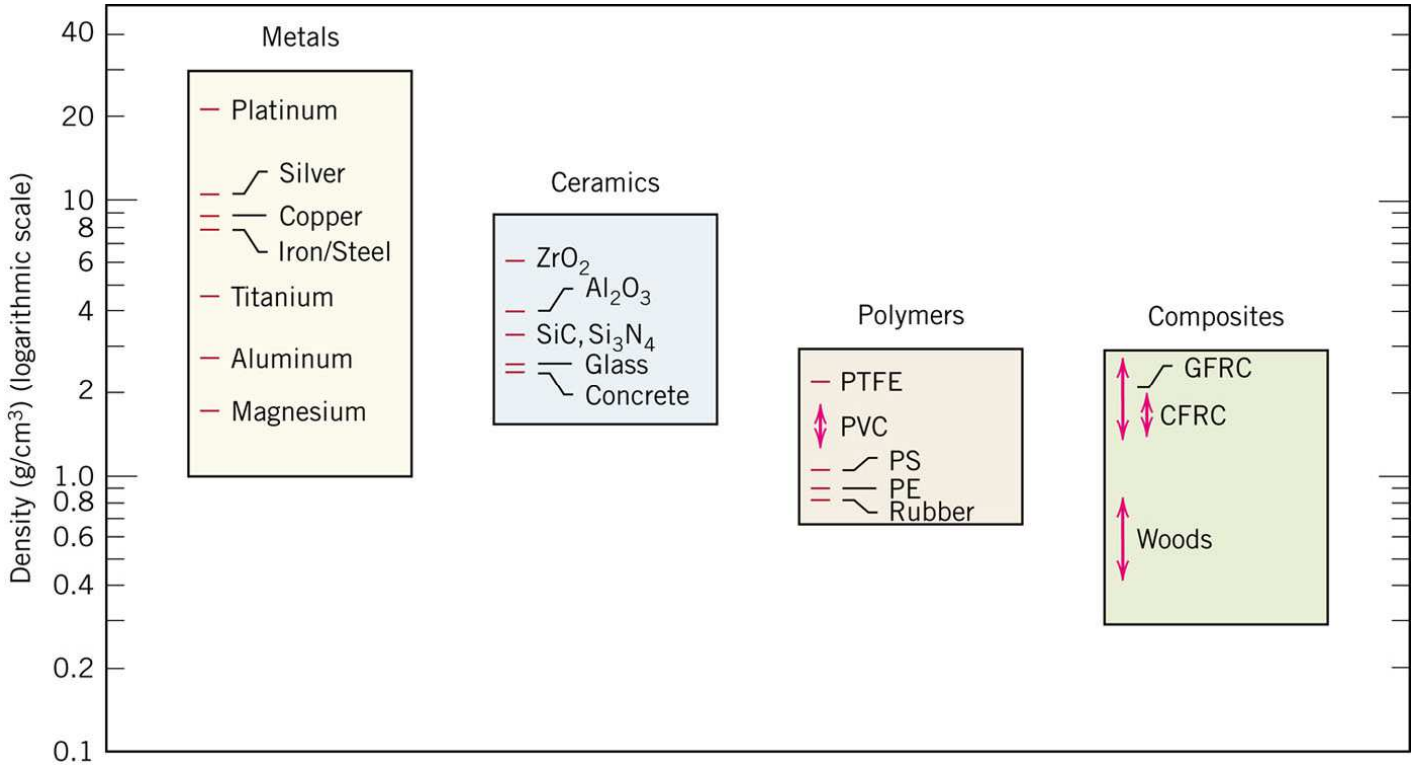
Density



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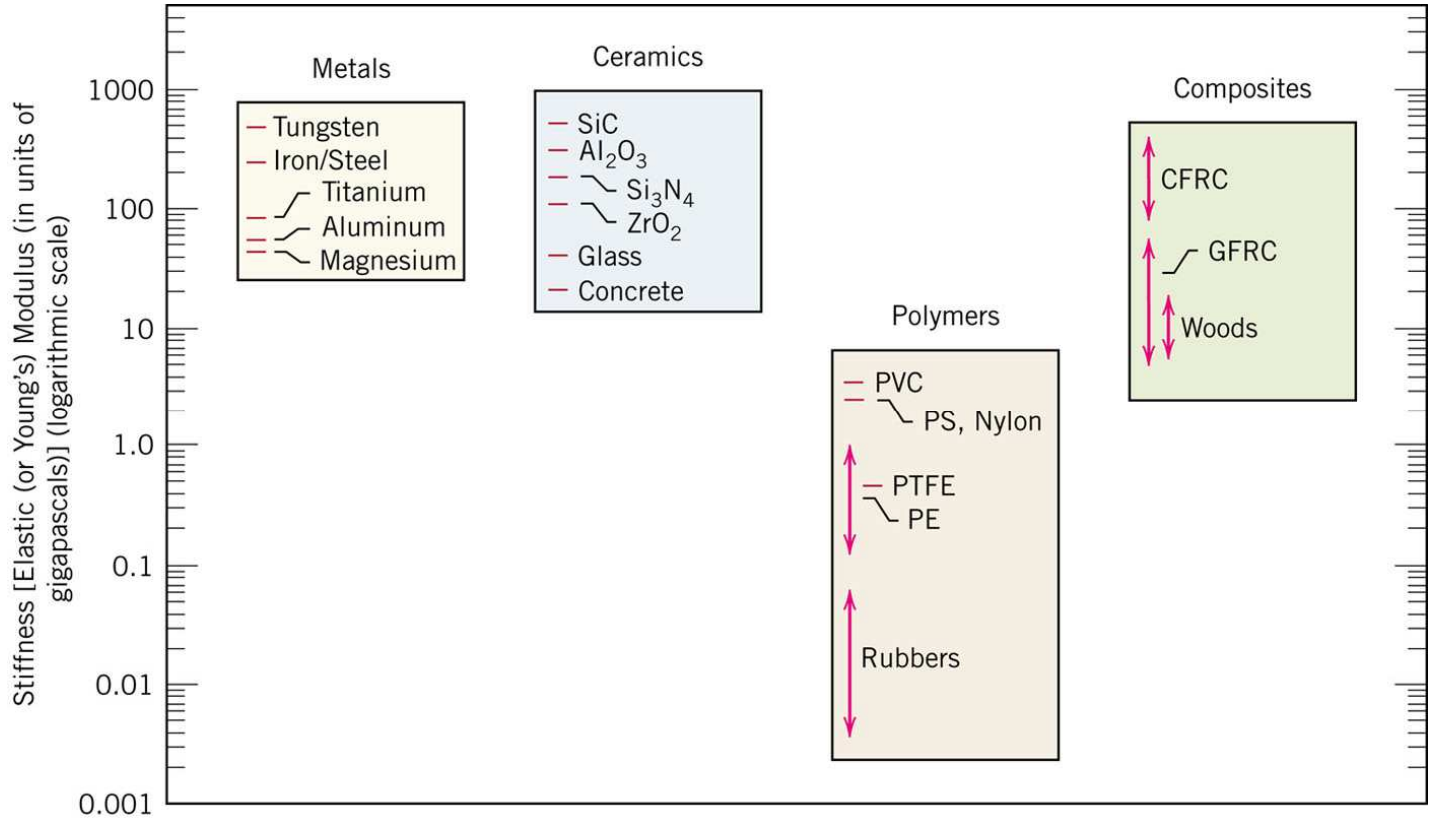
Stiffness

(measured by the elastic modulus)



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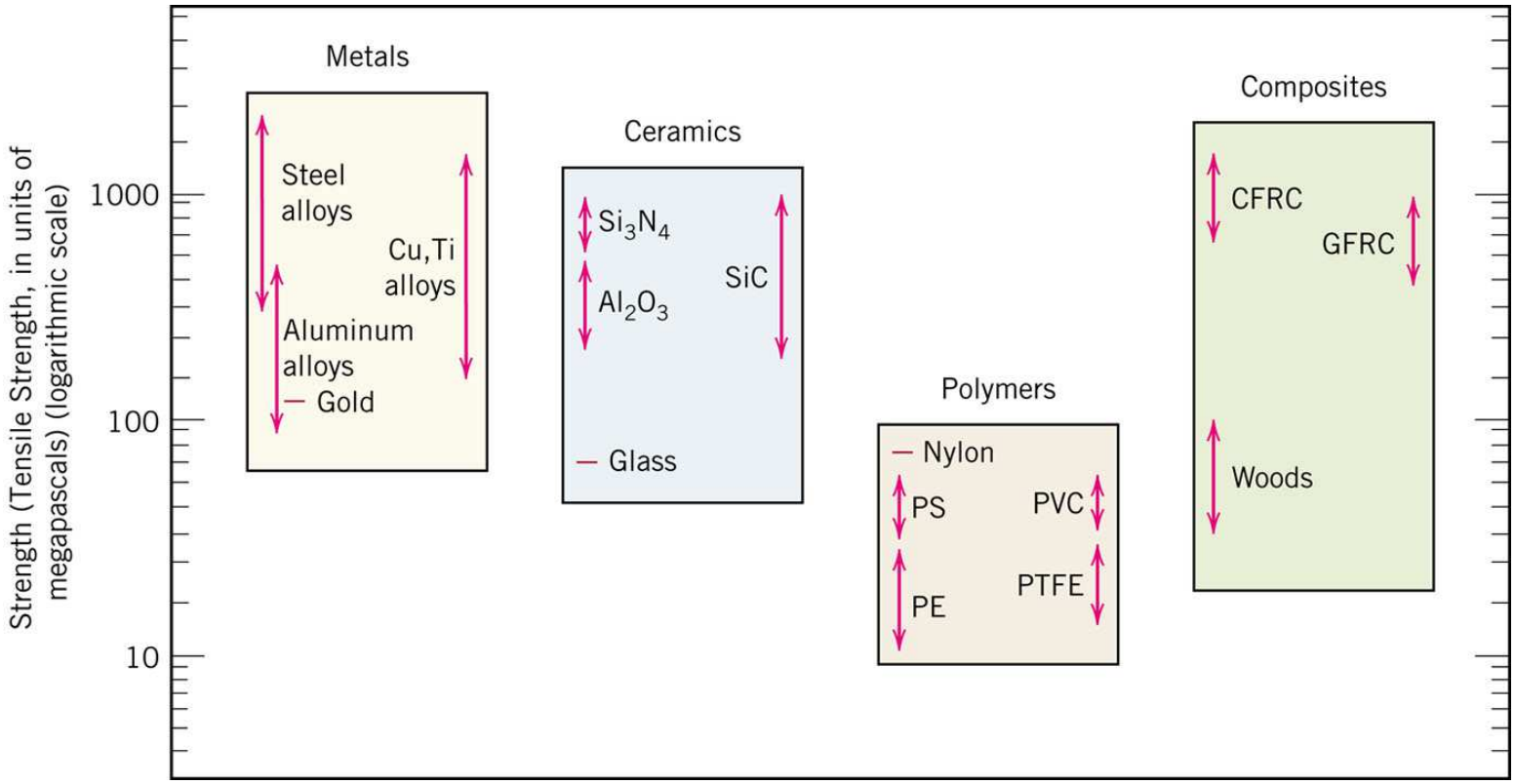
Mechanical Strength



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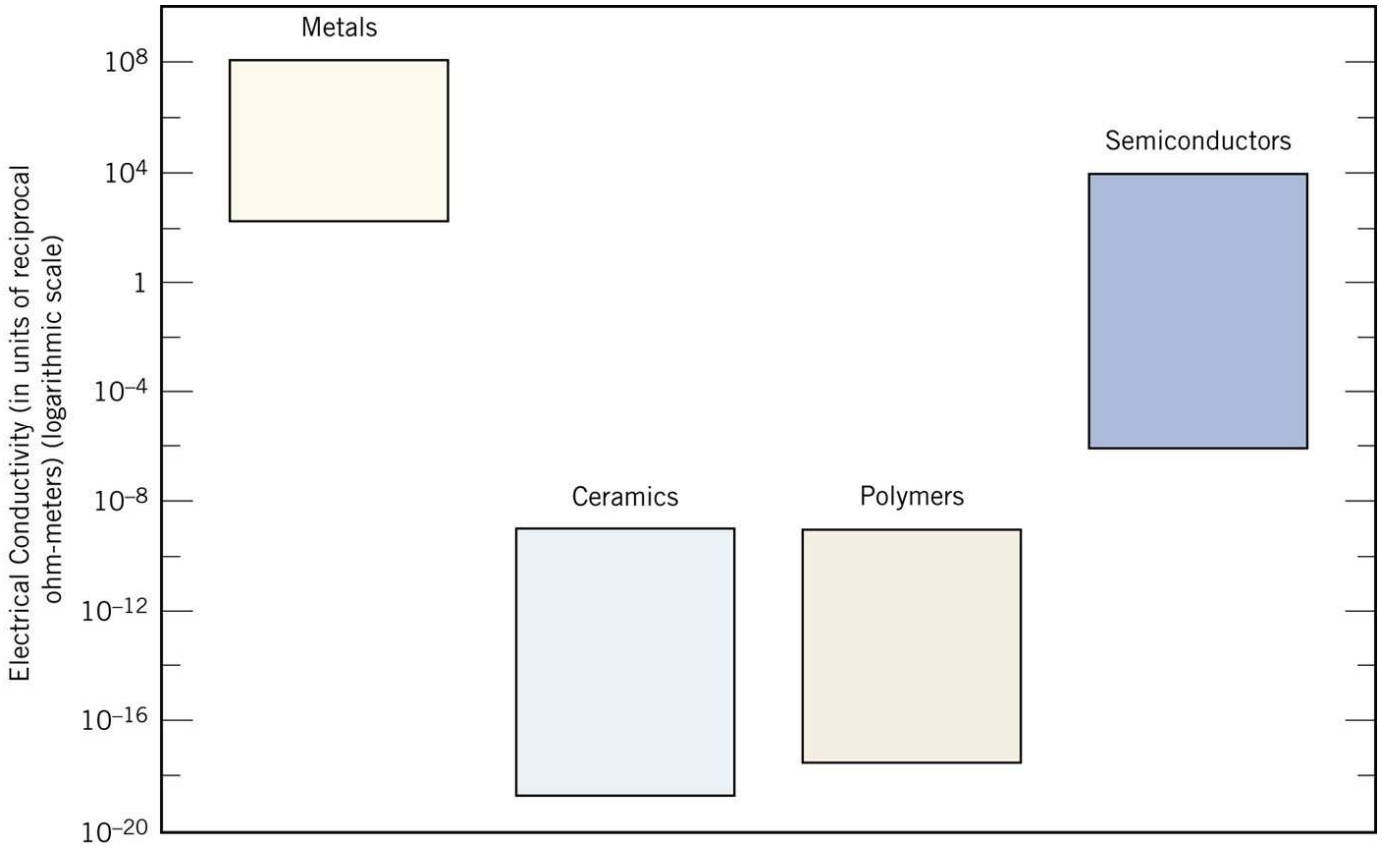
Electrical Conductivity



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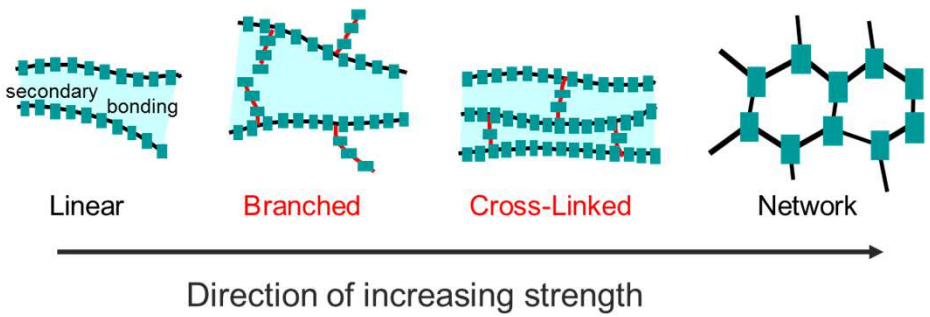
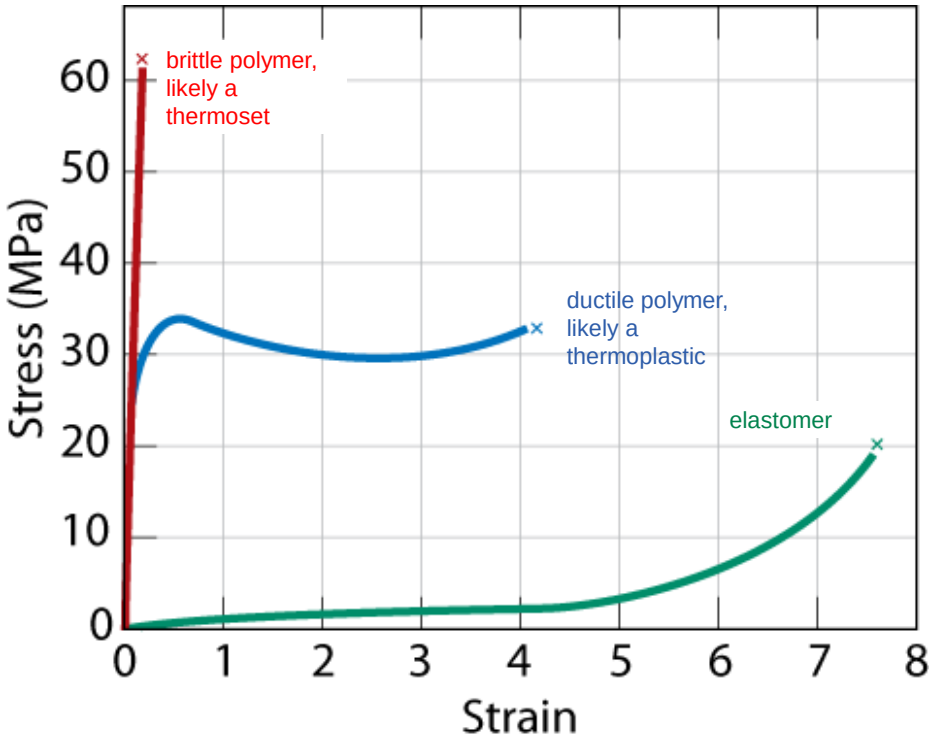
Mechanical behaviour

- Covalent chain configurations and strength:



Note that the thermoset has higher strength (it supports higher stress)



Note that “strain = 2”, for example, means an increase in length of 200%

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Mechanical behaviour

Video: tensile test of a HDPE sample

Daniel Samborsky, Montana State University

https://www.youtube.com/watch?v=I28m4FZzqro

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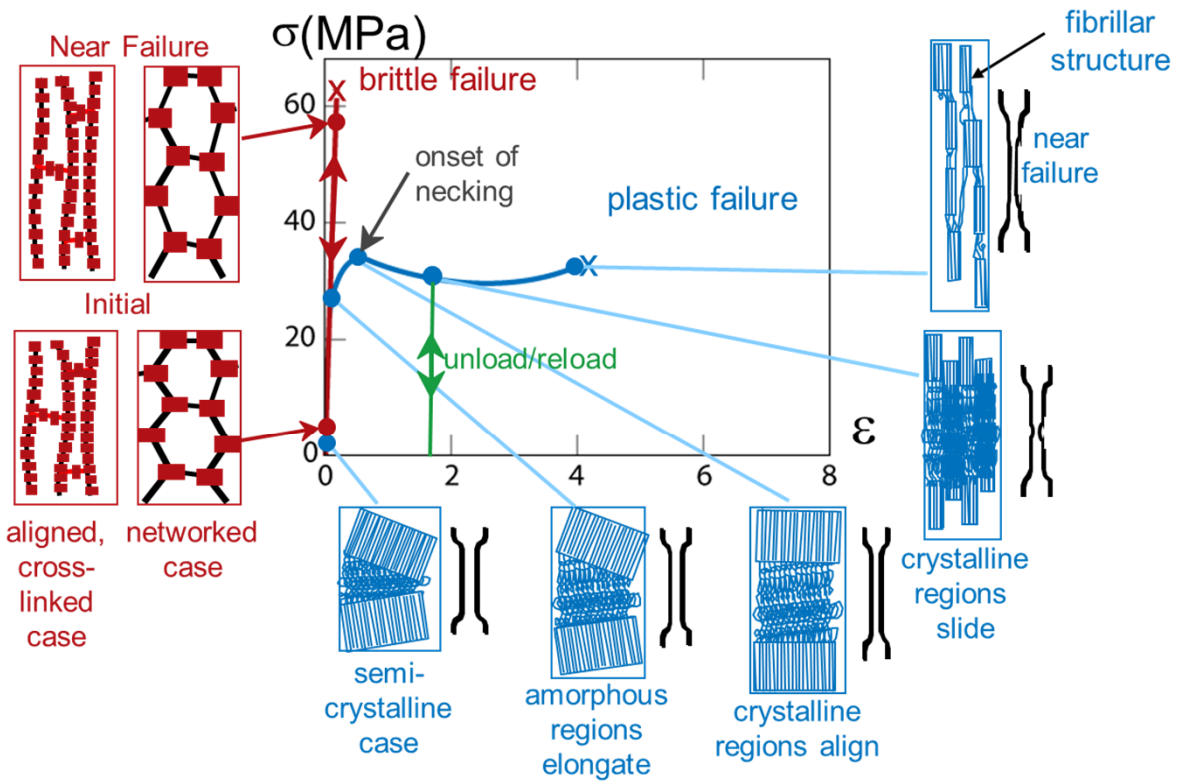
Mechanical behaviour

Tensile test



Stress-strain curves adapted from Fig. 15.1, *Callister 7e.* Inset figures along plastic response curve adapted from Figs. 15.12 & 15.13, *Callister 7e.* (Figs. 15.12 & 15.13 are from J.M. Schultz, *Polymer Materials Science*, Prentice-Hall, Inc., 1974, pp. 500-501.)

- Thermoplastics:
  - -- little crosslinking
  - -- ductile
  - -- soften w/heating
  - -- polyethylene
    polypropylene
    polycarbonate
    polystyrene
- Thermosets:
  - -- large crosslinking
    (10 to 50% of mers)
  - -- hard and brittle
  - -- do not soften w/ heating
  - -- epoxies, polyester resin,
    phenolic resin

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In summary

- Polymers have desirable properties such as low weight and low melting point (advantage in processing)
- Their mechanical behaviour can be understood based on their structure

References / Source Material

Materials Science and Engineering: an Introduction: William D. Callister Jr., David G. Rethwisch, John Wiley & Sons, New York

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Polymer structures

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