BME341 Biomaterials

Lecture #5

Mechanical Properties of Biomaterials

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Objectives of this course

- To understand and apply equations for calculation of stress and strain
- To understand stress-strain curves
- To understand the molecular mechanisms of elastic and plastic deformation in metals, ceramics and polymers
- To understand the molecular mechanisms of viscoelastic behavior

Mechanical Testing Methods

- Mechanical assessment of material is performed with a mechanical testing frame like that seen in Figure 1 (intentionally omitted) .
- Different fixtures can be attached to accomodate various testing modes.
- ASTM standards provide guidelines for testing modes and material types

Tensile and Shear Properties

Types of forces that can be applied to a material:

- ✓ Tensile
- ✓ Compressive
- ✓ Shear
- ✓ Torsion

Tensile Testing

- Load and specimen elongation are recorded during the test
- Engineering stress and engineering strain are calculated.

Compressive Testing

- Same equations are used with F taken to be negative since force acts on opposite direction.

Shear Testing

- Forces are applied parallel to the top and bottom faces of a sample
- Shear force causes sample deformation of angle θ

Stress-Strain Curve and Elastic Deformation

- Stress-Strain curves for metals, ceramics and polymers are described in Figure 2 (intentionally omitted).

- Where the stress and strain follow a linear relationship the sample undergoes elastic deformation.

- The slope is the Young's modulus.

Stress-Strain Curve and Plastic Deformation

- Plastic deformation is permanent
- Yield point signifies the start of the plastic region.
- Ultimate tensile strength