Third lecture

CHARACTERIZATION OF MATERIALS —1

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The characterization of materials is an important step to be taken before utilizing the materials for any purpose. Depending on the purpose one can subject the material to mechanical, thermal, chemical, optical, electrical, and other characterizations to make sure that the material under consideration can function without failure for the life of the final product.

1. MECHANICAL PROPERTIES

Among the most important properties for the application of materials in medicine and dentistry are the mechanical properties. We will study the fundamental mechanical properties that will be used in later.

1.1. Stress-Strain Behavior

For a material that undergoes a mechanical deformation, the stress is defined as a force per unit area, which is usually expressed in Newton's per square meter (Pascal, Pa)

Stress (σ) = $force \ / \ cross\text{-}sectional\ area\ (N\ /\ m2)$

A load (or force) can be applied upon a material in tension, compression, and shear or any combination of these forces (or stresses). Tensile stresses are generated in response to loads (forces) that pull an object apart (Figure

1a), while compressive stresses squeeze it together (Figure 1b). Shear stresses resist loads that deform or separate by sliding layers of molecules past each other on one or more planes (Figure 1c). The shear stresses can also be found in uniaxial tension or compression since the applied stress produces the maximum shear stress on planes at 45° to the direction of loading (Figure 1d).

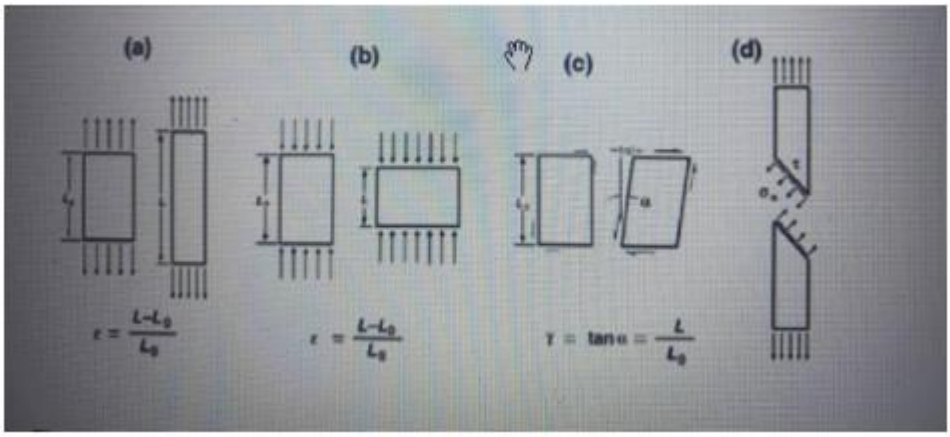

Figure 1. There different modes of deformation: (a) tension, (b) compression, (e) shear, and (d) shear in tension.