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Mechanochemically Active Polymers

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**Mechanochemically Active Polymers**

**What are Polymers?**
- Polymers are large molecules composed of many basic, repeating units called monomers.
- Molecular weights can range from 10,000 to over 100,000 amu.
- Polymers are typically organic, covalently bonded molecules.
- Composed mainly of Carbon, Hydrogen, Oxygen, Nitrogen and Silicon atoms.

**Mechanophores**
- Mechanochemically active polymers have been designed to contain clusters of chemically sensitive groups called mechanophores.
- Mechanophores are added directly to the backbone of the polymer.
- Mechanophores allow for more selective breaking of covalent bonds when a force is applied without weakening the overall material.

**Molecular Arrangement**
- The molecular structure of polymers varies by type from crystalline to amorphous.
- Crystalline polymers have atoms arranged in a set order or pattern.
- Amorphous polymers have a completely random molecular arrangement.
- Engineers alter the properties of polymers by changing the molecular arrangement.

**Polymerization**
- Monomers react to form polymers via the process of polymerization.
- The simplest of this type of reaction is called addition polymerization.
- Involves the movement of electrons by splitting a double bond into a single bond.

**Strength vs. Toughness**
- Tensile strength measures how far a material can be stretched before it fails.
- Compressional strength measures how far a material can be compacted.
- Measures how much force is required to break a material.

**Stress & Strain**
- Whenever a force is applied to a material some degree of deformation takes place.
- A material will return to its original condition until a specific amount of force is applied, once past that point deformation is permanent.
- How a polymer reacts to stress depends on its viscoelastic properties.

**Conclusion**
- The main goal of polymer engineering is to produce materials that are able to heal themselves when exposed to a damaging stress.
- Awareness of mechanical state through mechanophores is an important intermediate to that step.
- Applications include:
  - Incorporation into ropes used in rock climbing.
  - Use in airplane fuselages to detect damage.
  - Use in essentially any polymer or polymer composite product to detect damage.

**Sources**
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