Midterm-1 study

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According to chemical structure:
Metals -> metallic bond
Polymers -> long chain molecules
Ceramics-> alumino silicates
Composites-> combination of several materials

According to mechanical behaviour:
Elastic: they deform and when the load is removed, they return back to their initial poisiton.
Plastic: they deform and when the load is removed, they dont turn back to their inital position, there will be permanent deformation
Viscoelasstic: deformation depends on the rate of loading

Metals:
Metallic elements + small amount of nonmetallic (C, N, O)
compared to ceramics and polymers, metals are denser.
Atoms are arranged in a very orderly manner.
Stiff, strong and ductile
Good electricity and heat conductors <- nonlocalized electrons

Ceramics:
Metallic and nonmetalic (oxides, nitrides, carbides)
Relatively stiff and strong, very brittle
Low heat and electricity conductivity
Resistant to harsh environment than metals and polymers

Polymers:
Carbon, hydrogen based (+ O, N ,Si)
Plastic and rubber, organic compounds
Large molecular structure, chainlike, backbone of carbon atoms
Low density
Not strong, stiff but because of their low density, stiffnes and strength per mass basis are comparable to metals and ceramics
Extremely ductile, easily shaped
Low electric conductivity, soften and decompose at modest temperatures

Composites:
Two or more material from metals, ceramics, polymers
To achieve a combination of properties that are not displayed by a single material

Ductile: capable of large amount of deformation without fracture
Brittle: susceptile to fracture

GFRC: flass fiber reinforced concrete

Valence electrons: the outermost shell. Filled shells are more stable. Valence electrons participate in bonding between atoms. Physical and chemical porperties are based on valence electrons.
Bonding energy: the energy that is required to seperate two atoms to infinite seperation

Bonding energy increases if the interatomic distance decreases
Melting temperature is larger if bonding energy is larger
Thermal expansion coefficeint:

$$\frac{\Delta L}{L_o} = \alpha\,(T_2 - T_1)$$

Primary bonding:
1. Ionic
2. Covalent
3. Metallic

Atoms tend to be stable, fill their outer shells

Electropositive: tends to give up electrons
Electronegative: tends to acquire electrons
Electronegativity increases from left to right.

1. Ionic:

Large bonding energy
Metallic+ nonmetallic
Metallic gives, nonmetallic takes electrons
Dissimilar electronegativites
Predominant in ceramics

2. Covalent:

Bonding energy varies
Many nonmetallic elemental molecules
Sharing of electrons between adjacent atoms
Similar electronegativity

3. Metallic

Bonding energy varies
Metals and alloys
Sea of electrons, electron cloud

	ceramics	metals	polymers
Melting temp	large	moderate	small
Bonding energy	large	moderate	small
Thermal expansion coeff.	small	moderate	large
Primary bonding:	Ionic+covalent	metallic	Secondary+Covalent