Announcements

To join clicker to class today (Clickers with LCD display join automatically):

- Turn on the Clicker (the red LED comes on).
- Push "Join" button followed by "20" followed by the "Send" button (switches to flashing green LED if successful).

- Exam Friday.
- As usual, please wait to be let into classroom.

- Analytical reasoning quiz in discussion.
  - Sort and interpret data.
  - Use unfamiliar mathematical expression.
  - Reason by analogy.
  - Is one model preferred?

Review

- Common arrangements of silica tetrahedra in silicates:
  - Isolated (-4 per Si) – chains/rings (-2 per Si)
  - double chains (-1.5 per Si)
  - Sheets (-1 per Si) – Networks
- Amorphous substance are disordered at the molecular level. Ex. glass.
- Color of most minerals due to localized transitions on transition metal ions.
  - d-orbital energy levels split by ligands.
  - Octahedral and tetrahedral environments.

Crystal Field Splitting in Octahedral Complexes

Chang Figure 20.11

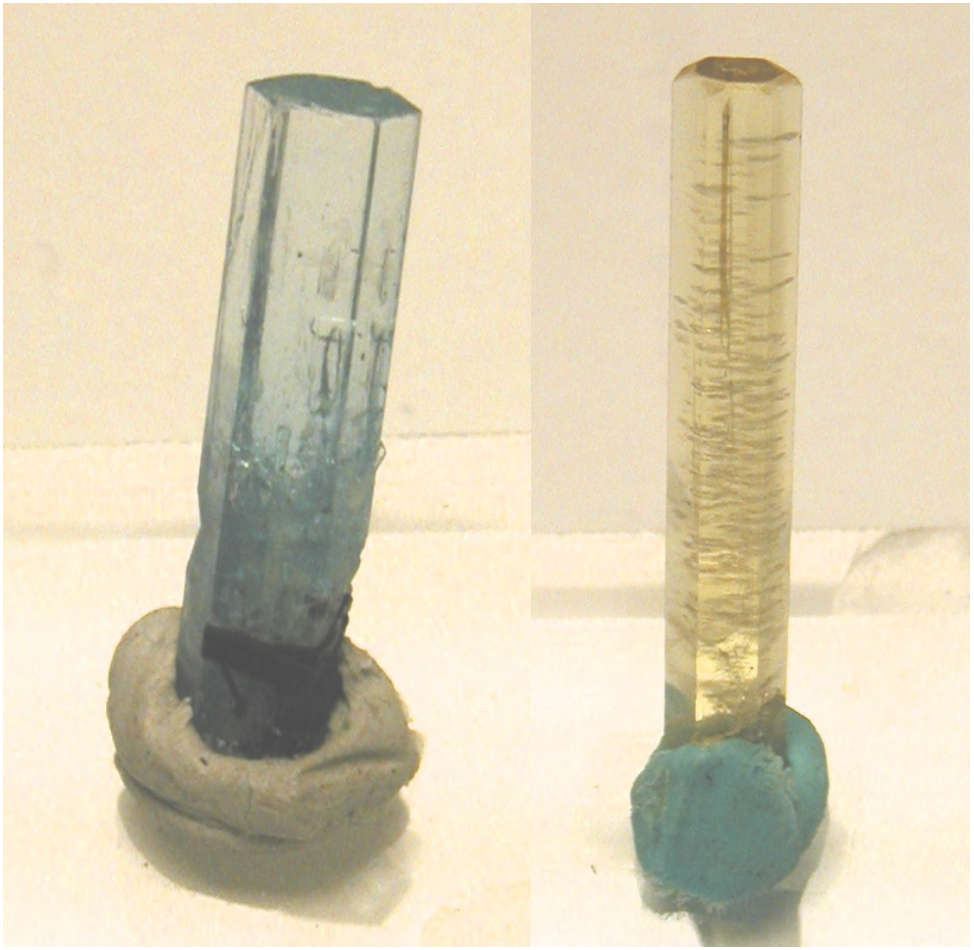
Chang Figure 20.12

Crystal Field Splitting in Tetrahedral Complexes

Chang Figure 20.18

Beryls

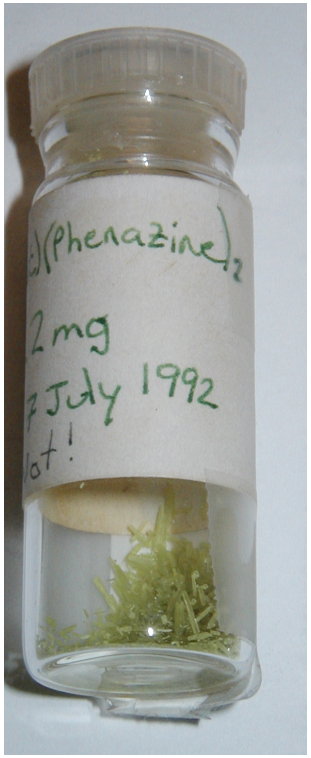
$Be_3Al_{2-x}(Cr, Fe)_xSi_6O_{18}$

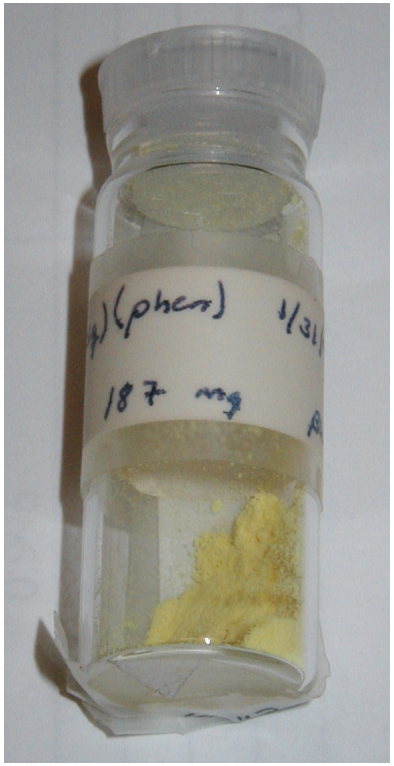


Absorbance of Emeralds

Zn^{2+} tetrahedral complexes

Courtesy of Dr. Wacholtz





Wavelength Transmitted/ reflected	~565 nm	~580 nm	~605 nm
Wavelength Absorbed (d-d) transition	~600	~610	~640

(note the ligands absorb in the UV to blue range 350-400 nm

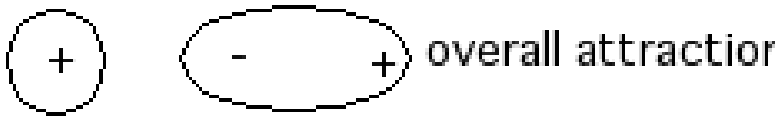
High Spin vs. Low Spin

Chang Figure 20.17

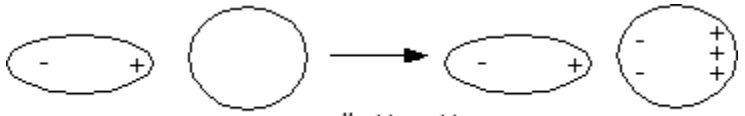
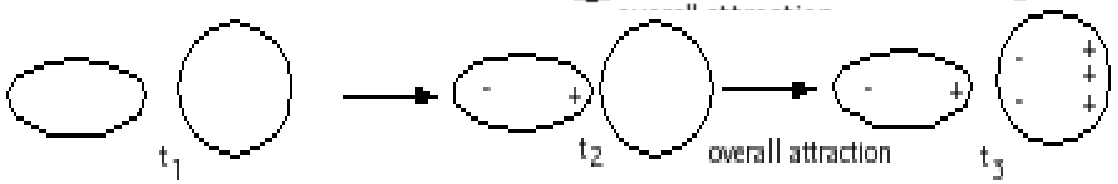
The End

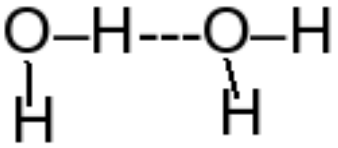
Finis

Review

- attractive interactions among molecules:
  - ion-dipole 

  - dipole-dipole 

  - dipole - induced dipole 
  - Dispersion 

  - Hydrogen bonding (directional partial bond, on H bonded to N, O or F). H–F---H–F---H–F and 

- Attractions explain properties of liquids (surface tension, meniscus, capillary action).

Review

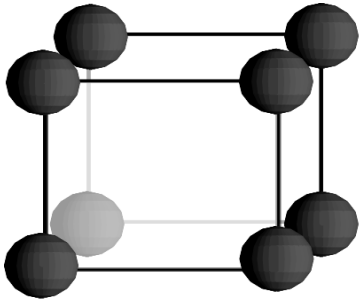
- Attractions explain properties of liquids (surface tension, meniscus, capillary action, viscosity).
- Properties of liquids determined by intermolecular interactions.
- Ion-ion interactions and Lattice energy: $U=k(q_1q_2/d)$
  - U is energy per mole of formula units (e.g. mole of NaCl or $CaCl_2$, etc)
  - k = a constant that accounts for geometry and the factor of N_A
- Solubility of ionic compounds depends on the balance between the energy released by solvation (hydration) of ions and the energy necessary separate the ions.

Review

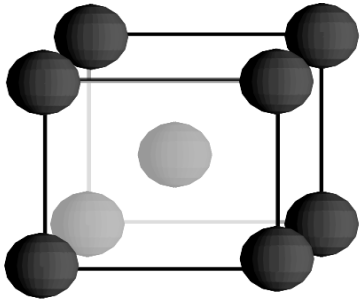
- For molecular compounds “like dissolves like”.
- Vocabulary:
  - miscible means the liquids are soluble in each other.
  - Immiscible means the liquids do not mix.
- Reading phase diagrams (normal boiling point, T_{trip}, T_c, phase boundaries)
  - Most solids more dense than liquid (s-l boundary positive slope)
  - On boundaries both phases can exist.
- Raoult's Law: $P_{vap} = X_{solvent}P^{\circ}_{solvent}$

Review

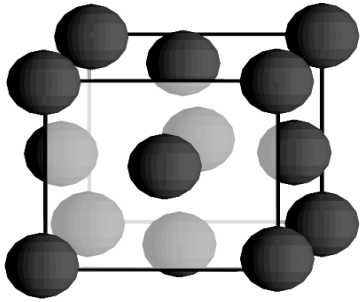
- X-ray diffraction (small lattice spacing larger diffraction angles).
- Crystalline solids (scc, bcc and fcc lattices)



Simple Cubic



Body Centered Cubic



Face Centered Cubic

  - Volumes of different lattices in terms of radius of atoms:
- $V_{cubic} = 8r^3$, $V_{bcc} = \left(4/\sqrt{3}\right)^3 r^3$ $V_{fcc} = \left(16\sqrt{2}\right)r^3$
  - Calculated densities using this information.
  - Other things you can calculate (practice problems in text): Use density and unit cell size to get # of atoms per unit cell and ID type of unit cell. Unit cell type and density to get unit cell dimensions.

Review

- In ionic lattices the positive ion fits into the holes between the negative ions.
  - In fcc there are both octahedral and tetrahedral holes.
  - Octahedral bigger (hold cations of > 50% size of anions).
  - Tetrahedral smaller (hold cations <40-50% size of anions).
  - If ions about same size tend to form scc (bcc) crystals.
- When calculating density of ionic crystal need to account for number of both types of ions in the unit cell.

Review

- Molecular solids = individual molecules held together by intermolecular interactions (sometimes crystalline/well ordered).
- Allotrope = different forms of same element (graphite, C_{60} and diamond).
- Models of metallic bonding
  - Electron sea (Jellium) model.
  - Band theory of solids (also explains semi-conductors and insulators).
- Network solids = rigid array of bonded atoms. (diamond and silicates are examples).

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- Color of most minerals due to localized transitions on transition metal ions.
  - d-orbital energy levels split by ligands.
  - Octahedral and tetrahedral environments.
  - High spin versus, low spin configurations.