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CHEM 3420: Physical Chemistry II — Spring 2009

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Lecture 16: Additional applications of atomic spectroscopy

References

1. Levine, *Physical Chemistry*, 20.2
2. Photoelectron spectroscopy paper

Key Concepts

- X-ray spectroscopy can be used to identify and quantify the composition of solid samples. Plus it relates directly to the relationship between atomic structure and observed properties.
- *Photoelectron Spectroscopy (PES)* is a technique that allows us to determine the binding energies of all electrons an atom at once. It can be used to confirm our orbital/shell model of electronic structure.
  - The technique employs a high-energy photon (x-ray) that as enough energy to remove electrons from any energy level within the atom. The energy of the scattered electron is measured and the binding energy can be calculated.
  - Uses our understanding of electronic transitions:

    $$E_{incident} = \Delta E_{transition} + E_{scattered}$$

    In this case, the incident energy is the energy of the incoming photon, the transition energy is the energy required to remove that particular electron from the atom (the binding energy), and the scattered energy is the measured kinetic energy of the ejected electron.

    $$h\nu_{incident} = BE + \frac{1}{2}mv^2_{scattered}$$

- The energies measured and calculated are the binding energies of the electrons. The energy required to remove the most loosely held electron is what we had previously referred to as the ionization energy.
- The relative heights of the peaks is proportional to the population of a particular orbital level. The more electrons, the higher the peak. (See the spectrum from the lecture posted on Blackboard)
- PES allows for the measurement of all the ionization energies of a particular element at once and also confirms our orbital/shell model derived from the Schrödinger Equation.