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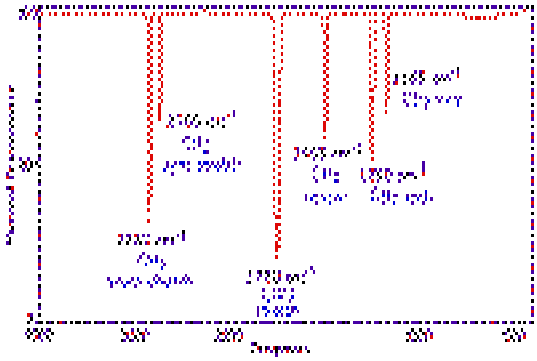
Biomedical Seminar
Infrared Spectroscopy

Spectroscopy is the study of spectra. Spectra deals with the dependence of physical quantities on frequency. It is most often used with physical and analytical chemistry for the identification of substances. Infrared spectroscopy deals with the infrared range of electromagnetic radiation, which is out of our visible range. Photon energies from the infrared are not large enough to excite electrons but induce vibrational excitation of covalently bonded atoms and groups. Covalent bonds in molecules act like stiff springs that can be stretched and bent. Molecules experience a wide variety of vibrational motions, characteristic of their component atoms. All organic compounds absorb infrared radiation that corresponds in energy to these vibrations. This (with the use of IRS) allows us to obtain absorption spectra of compounds that are unique of their molecular structure. A molecule with n-atoms has 3n degrees of freedom. 6 of these degrees of freedom are translations of the molecule itself. This leaves 3n-6 degrees of vibrational freedom. The exact frequency at which a certain vibration may occur is related to the strengths of the bonds and the mass of the component atoms. Different absorptions are due to different types of motion between the atoms in the molecule. These molecules follow certain rules which correspond to the graph:



Stretching frequencies are higher than bending frequencies and etc. These graphs help determine isotopes. This technique of infrared spectroscopy can be used to study the change of molecular structure of the Calcium ATPase upon a reaction cycle in which calcium is pumped back into the sarcoplasmic reticulum to prevent muscle contraction. This reaction cycle includes the use of ATP breaking apart and adding a phosphate group to the Calcium ATPase protein. By using different absorbant spectrums, alot of information can be derived from these output graphs. Looking at different spectrums tell different aspects of the molecules and proteins that are being used.

References:

- http://w3.dbb.su.se/~barth/ca-atpase-e.html
- http://www.cem.msu.edu/~reusch/VirtTxtJml/Spectrpy/InfraRed/infrared.htm
- www.wikipedia.com
- "Structural Changes of the Sarcoplasmic Reticulum Calcium-ATPase upon Nucleotide Binding Studied by Fourier Transform Infrared Spectroscopy", Biophysical Journal: Frithjof von Germar, Andreas Barth, and Werner Maentele.
- "Infrared Spectroscopic Investigations of Pulmonary Surfactant", Richard A. Dluhy, Kim E. Reilly, Rodney D. Hunt, Melody L. Mitchell, Alan J. Mautine & Richard Mendelsohn.