Infrared Spectroscopy

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In this tutorial we will review scientific topics involving a most important analytical tool in which virtually any sample, crystals, liquids, solutions, pastes, powders, films, fibres, gases and surfaces can be studied using current easily available accessories. Infrared spectroscopy, spanning from 20 to 13000 cm^{-1}, is a comprehensive tool for the quantitative study of vibrational modes in terms of changes in electric dipoles associated with vibrations and rotations. In addition, the electronic structure, as in highly correlated materials from regular transition metal oxides to high Tc cuprates, may also be probed through the interplay of external variables such as quasihydrostatic pressure, temperature, and applied magnetic fields. This yields information of instabilities of great interest to solid state research.
Infrared spectra are based on Fourier spectroscopy that is a powerful technique applied to transmission as well as reflectivity measurements and built on the Michelson Interferometer. An interferogram is created that it is Fourier transform to obtain transmission (absorption) as function of frequency. Then the optical properties are deduced by Kramers-Kronig integration or a dielectric simulation (using damped oscillators and plasma) of the reflectivity spectra. This allows the knowledge of the dielectric function real and imaginary parts yielding a complete low energy characterization
We will also see more recent applications on biology where now the samples of interest are biomolecules, very complex systems such as protein, nucleic acid, carbohydrate, lipid, or biomembrane structure where spectroscopic IR-microscopy helps bridging data from X-ray cristallography that otherwise would be intractable.

Infrared Spectroscopy: Fundamentals and Applications B. Stuart 2004, http://media.wiley.com/product_data/excerpt/86/04708542/0470854286.pdf#search=%22introduction%20%2B%20%20infrared%22

M. S. Dresselhaus. Optical Properties of Solids
http://web.mit.edu/afs/athena/course/6/6.732/www/opt.pdf

F. Wooten, Optical Properties of Solids, Academic Press, 1972.

See for example, D. Nauman on *Infrared Spectroscopy in Microbiology*, Encyclopedia of Analytical Chemistry, R. A. Meyers (Ed.) , John Wiley and Sons Ltd , Chichester, (2000). Pp. 102-131.

L. Miller. Biomicrospectroscopy
file:///C:/Documents%20and%20Settings/Administrador/Configuraci%F3n%20local/Archivos%20temporales%20de%20Internet/Content.IE5/KRBV2K19/431,1,Diapositiva 1

Project for an infrared-beamline at the Swiss Light Source
http://www.solidphys.ethz.ch/spectro/DOC/SLS/slsreport.pdf#search=%22Project%20for%20an%20infrared-beamline%20at%20the%20Swiss%20Light%20Source%22