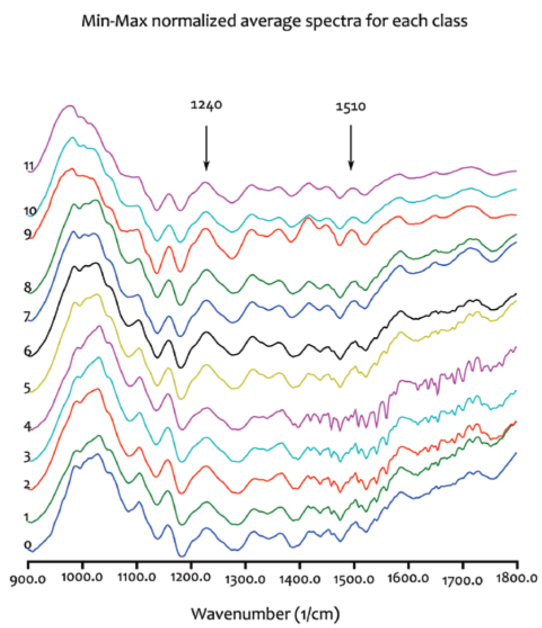
Mid-Infrared Beamline (MidIR)

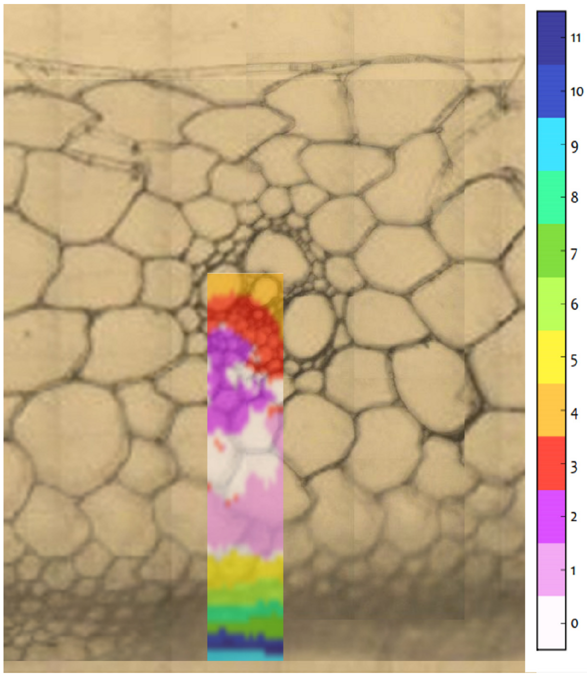
The mid-IR beamline, ranging from 560 to 6000 cm^{-1} or 0.070 - 0.744 eV, is used for high-spatial resolution spectromicroscopy. This makes it an effective tool to perform spectroscopy and mapping experiments on microscopic regions of a sample (routinely 6 microns by 6 microns in size, down to 3 by 3 in some cases). Absorption of light in the infrared region of the spectrum causes the atomic bonds of molecules within a material to vibrate and rotate. This absorption can be measured and displayed as a spectrum of lines, or a spectral signature, that is unique to the molecule and provides insight into the structure of that molecule. The infrared absorption spectrum of most materials is one of the most highly characteristic properties of that material and can be used both to identify the material and to deduce its molecular and chemical properties. Vibrational spectroscopy within the mid-infrared range of the electromagnetic spectrum is one of the techniques available on this beamline, and is ideal for studying the structure and mechanism of biological molecules.

An example of the use of this technique is a study of barley stems to better understand the potential of plant biomass for the production of biofuel (Fodje, A. Canadian Light Source Activity Report 2008). The MidIR beamline was used to create a map of the tissue of a barley stem section. The stem tissues contain different types of cellulosic material, with biodegradable cellulose being of primary interest as it can be used for ethanol production. Each type of cellulosic material produces a spectrum characteristic of its properties when it absorbs infrared light, and 12 different classes of material were identified based on the spectra (top of next page).



Absorption spectra of 12 classes of cellulosic material found in a barley stem section (CLS Activity Report, 2008. p. 136).

From this data, a map was developed to indicate the location of these different classes of cellulose within the stem section. The figure below shows a visible image of the barley stem tissue, with the different classes of cellulose mapped as an overlay, color-coded to match the spectra. This demonstrates the capability of this technique for studying cellulose in plant biomass, which contributes to research in the production of biofuels. Other applications range from semiconductor analysis to art conservation to medical diagnosis and freezing resistance of plants.



Microscope image of a barley stem section, with a map of the 12 classes of cellulosic compounds overlaid on the region that was analyzed. The color indicates each of the different classes (CLS Activity Report, 2008).