Research highlight

Synchrotron-based FTIR microspectroscopy of chili resistance induced by *Bacillus subtilis* strain D604 against anthracnose disease

SR-FTIR microspectroscopy can be used as a tool to examine the biochemical changes within plant tissue. This study suggested that the *Bacillus subtilis* strain D604 induced resistance against anthracnose pathogen in chili by inducing cellular changes related to defense compounds involved in plant defense mechanism.

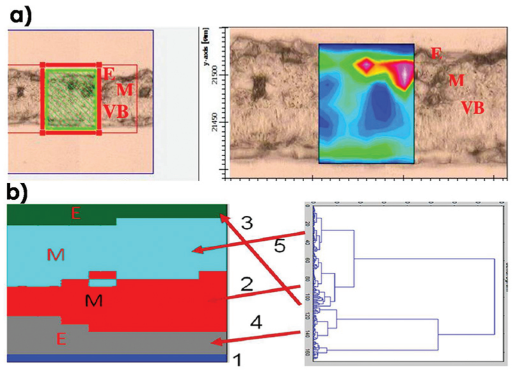

Figure 4: a) Functional group mapping from the amide I protein (1700 - 1600 cm^{-1}) of chili leaf cross section. b) Hierarchical Cluster Analysis (HCA) map performed using five clusters encoded by different colors. Mesophyll (cluster 2 and 5) and epidermis (cluster 3 and 4). (K. Thumanu et al., 2017).

Analysis of contaminations in plastic raw materials

Micro analysis with FTIR microspectroscopy can be used for identification of the brown spot contaminant in polyethylene pellet.

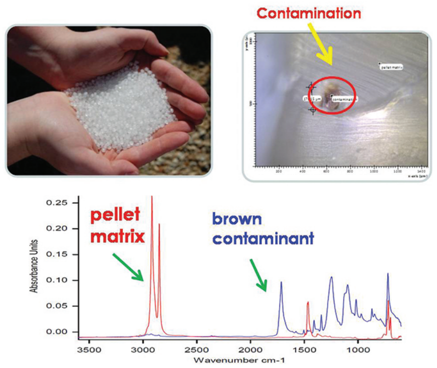

Figure 5: The spectrum of brown spot contamination was detected and identified from polyethylene pellet. (Bruker Optik GmbH-Ettlingen, German).

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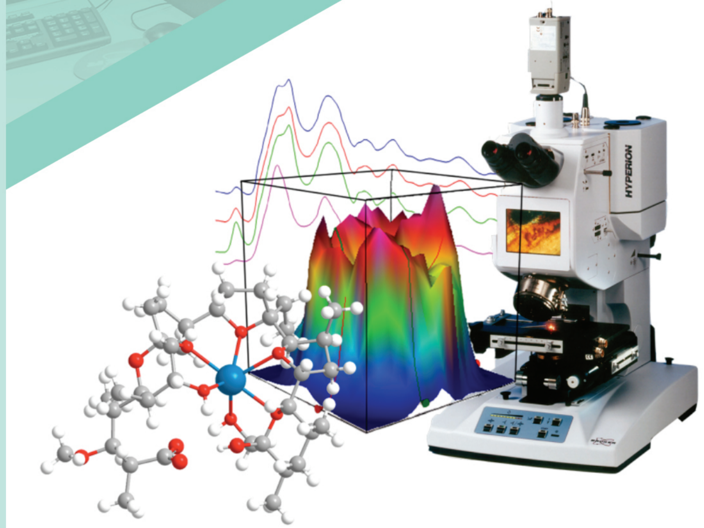
Siam Photon



BL4.1:

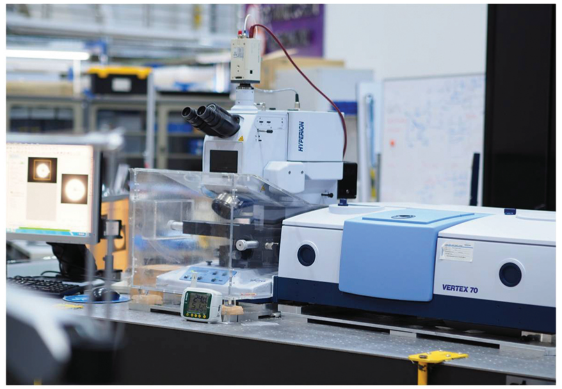
Infrared Spectroscopy and Imaging (IR)

Synchrotron Light Research Institute (Public Organization)

www.slri.or.th

Technical specifications

- **Photon Energy range:**
  0.01 - 0.50 eV
- **Wavelength:**
  2.5 - 100 microns
- **Source:**
  Edge and Bending Magnet Radiation
- **Beam size at sample:**
  10 x 10 μm^2
- **Spectrometer:**
  Vertex 70 spectrometer
- **Microscope:**
  Hyperion 2000 microscope
- **Detector:**
  100 micron Narrow band MCT
- **Objectives:**
  36X Schwarzschild Objective
  20X ATR Objective
- **Experimental techniques:**
  Transmission
  Reflection
  Attenuated Total Reflectance (ATR)



Beamline 4.1:
IR Spectroscopy and Imaging

Infrared microspectroscopy is a valuable technique for chemical analysis of molecules. With the high brightness of synchrotron radiation, synchrotron based Infrared microspectroscopy (SR - IR) can provide the high spatial resolution, good signal to noise ratio and short data acquisition time.

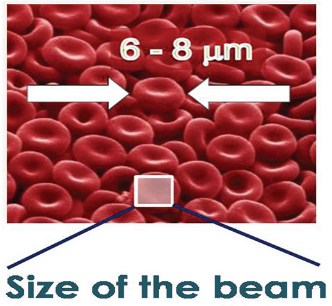
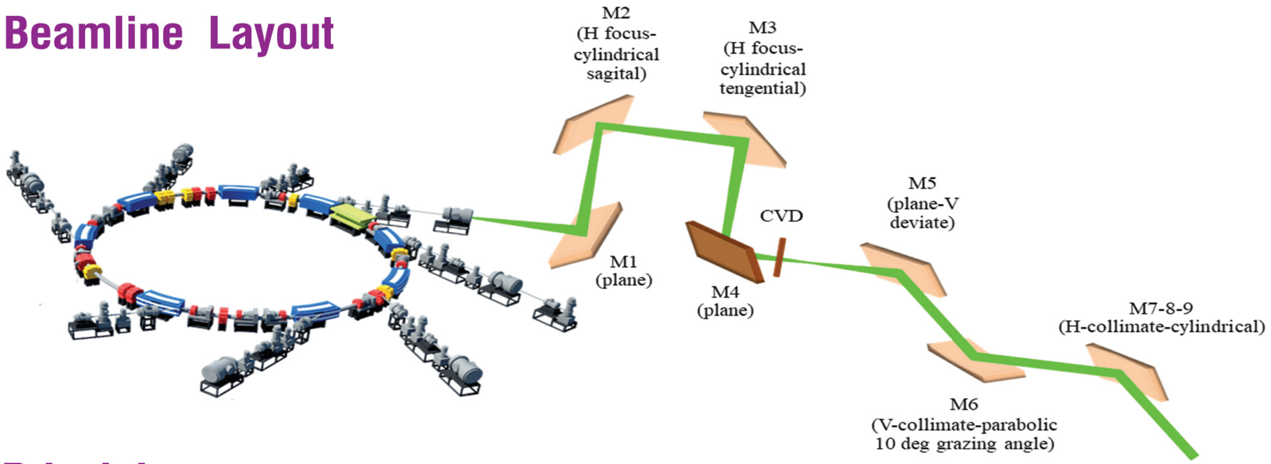


Figure 1: Illustration of the advantage provided by using synchrotron source for infrared microscopy (https://www.popsci.com/article/science/-first-red-blood-cells-made-adult-cells-ready-human-transfusions).

Beamline Layout



Principles

The infrared beamline (BL4.1: IR) was designed to collect both edge and bending magnet radiation from the BM4 of the 1.2 GeV storage ring at the Siam Photon Source. The measurement of absorption spectrum and image can be covered the mid - infrared spectral range (4000 - 400 cm^{-1}). The coupling between Synchrotron - IR spectrometer and Hyperion 2000 IR microscope, this technique can be used to measure samples with a spatial resolution of 10 x 10 µm^2.

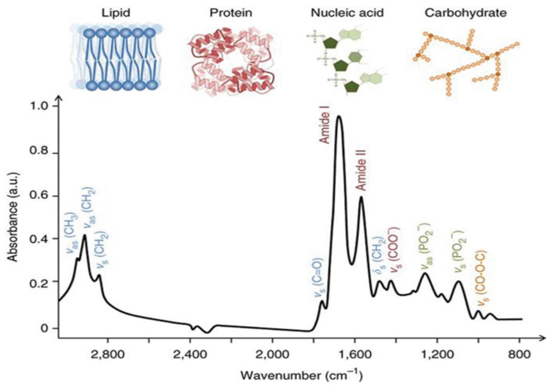


Figure 2: The main biological band assignments of cells and tissues are shown: lipids, proteins, nucleic acids (phospholipids) and carbohydrates in the spectral ranges from 3000 - 2800 cm^{-1} and 1800 - 800 cm^{-1}. (M.J. Baker et al., 2014).

The FTIR spectral data combined with multivariate data analysis in particular Principal Component Analysis (PCA) can be applied to study biochemical changes in the samples.

Applications

Food and Agricultural sciences:

Plant tissue, Animal feed science and animal nutrition, Meat quality assessment and Soil sciences

Biomedical sciences:

Stem cells based therapy, Cancer diagnosis, Bone and cartilage etc.

Polymer sciences:

Homogeneity of polymer composites, Multi-layers thin films of polymer laminate

Material sciences:

Corrosion studies of thin metal oxides, Contaminant identification for microelectronics industry

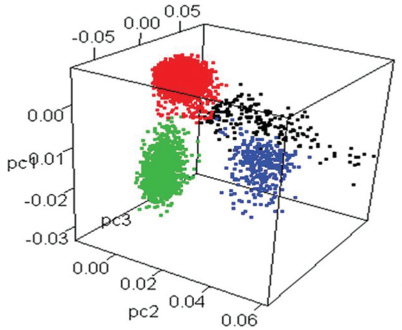


Figure 3: Classification of FTIR spectra by using PCA