

Nano Forensic Science News

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The world's largest
third-generation
synchrotron radiation facility

Exposing the Truth by SR Nanobeam: The huge microscope, SPring-8, sustains a secure and safe society

1. Introducing FTIR microscopy using synchrotron radiation of SPring-8

- 1.1 VERTEX70&HYPERION2000 installed at the BL43IR beamline
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2. Example Analysis of trace particles using FTIR microscopy with synchrotron radiation

- 2.1 Trace of pesticide methamidophos crystal
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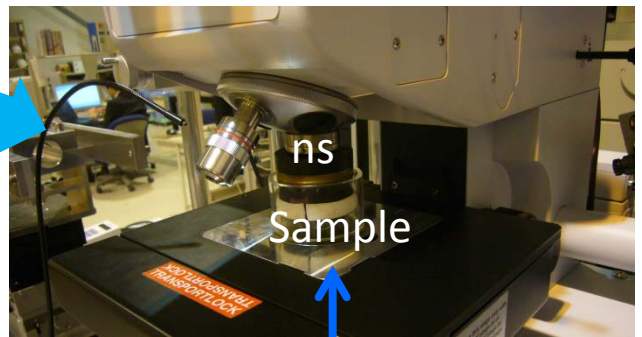
3. Reference

Forensic Science:
A discipline of a broad spectrum of sciences to investigate and elucidate evidences relating to criminal or civil law.

1. Introducing FTIR microscopy using synchrotron radiation of SPrng-8

1.1 VERTEX70&HYPERION2000 installed at the BL43IR beamline

At BL43IR beamline of SPrng-8, Bruker VERTEX70& HYPERION2000 FTIR microscope is installed and plays an active part in the analysis of an extremely minute samples using synchrotron radiation of SPrng-8.



Sample stage

1.2 Characteristic of FTIR microscopy using synchrotron radiation

Differences between FTIR using synchrotron radiation at SPrng-8 and conventional FTIR are shown below.

	FTIR microscope using synchrotron radiation	Conventional FTIR microscope
Characteristic	Suitable at analyzing of samples smaller than 10 microns	Difficult to analyze samples smaller than 10 microns

Conventional microscopic FTIR are available at all the forensic science laboratories in every prefecture in Japan, and uses to analyze a minute of vehicle's coating pieces, fiber pieces and pharmacopoeia nondestructively.

It has been difficult to analyze of extremely small samples because conventional microscopic FTIR requires large samples.

Bruker VERTEX70&HYPERION2000 installed at SPrng-8 is powerful tool when the samples are too small to be analyzed by existing conventional microscopic FTIR.

In addition to that, the enormous infrared databases of materials related to criminal investigation are compiled and are available for analysis at BL43IR.

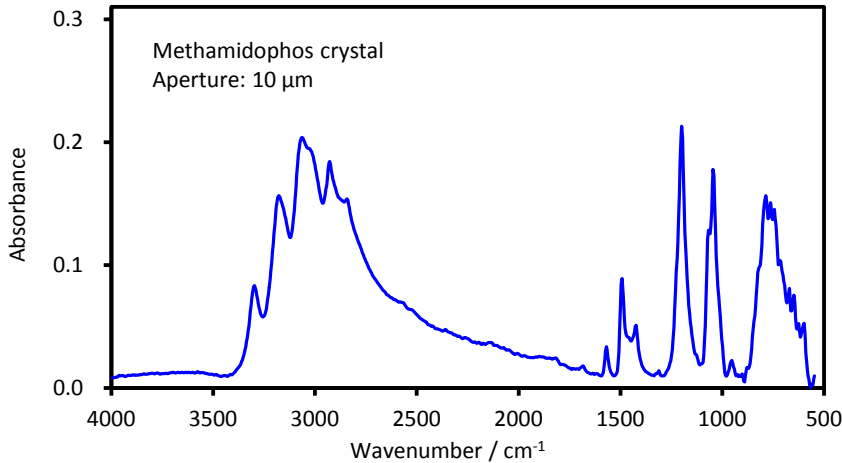
2. Example analysis of trace particles using FTIR microscopy with synchrotron radiation

Shown below are the example analysis of pesticide methamidophos microscopic crystal, and the ℓ -ephedrine hydrochloride and methamphetamine hydrochloride being taken from finger-tips.

When $2\ \mu\text{m}$ aperture is used, the signals become weak less than $1000\ \text{cm}^{-1}$, but we can confirm the characteristic peak of each crystal from $3000\ \text{cm}^{-1}$ to $1500\ \text{cm}^{-1}$.

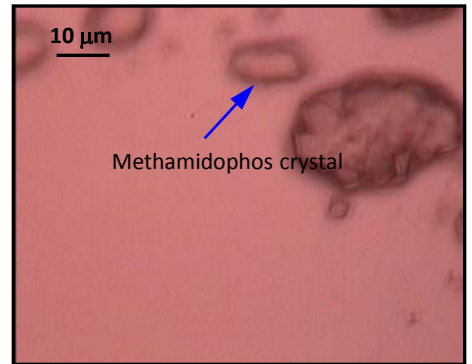
Moreover, the minute of methamphetamine crystal can be identified using microscopic Raman analyzer.

2.1 Trace of pesticide methamidophos crystal



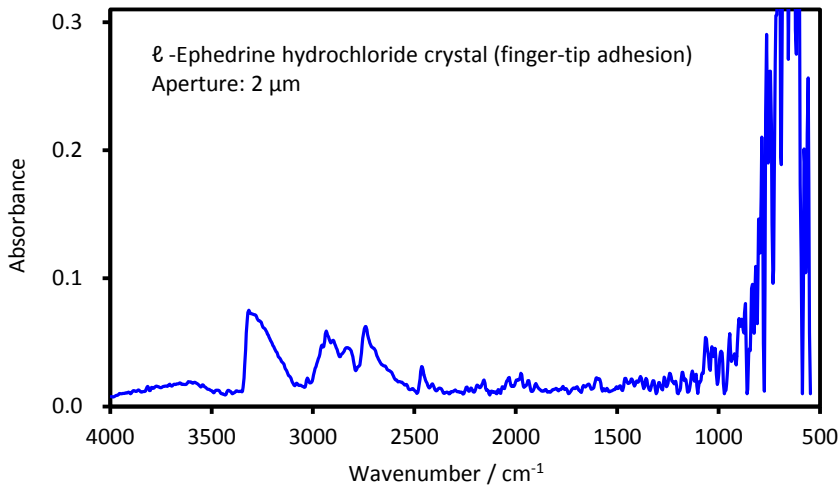
An object lens: x36
Resolving power: $8\ \text{cm}^{-1}$, 640 scan, measurement time 68 secs

The crystal
appearance
10 microns



Transmission microscope image
(on BaF_2) SR-IR device @BL431R

2.2 Trace of ℓ -ephedrine hydrochloride crystal



An object lens: x36
Resolving power: $8\ \text{cm}^{-1}$, 640 scan, measurement time 68 secs

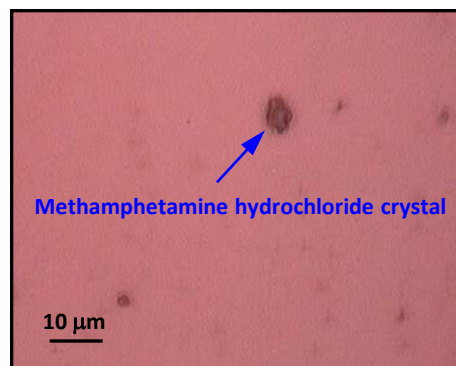
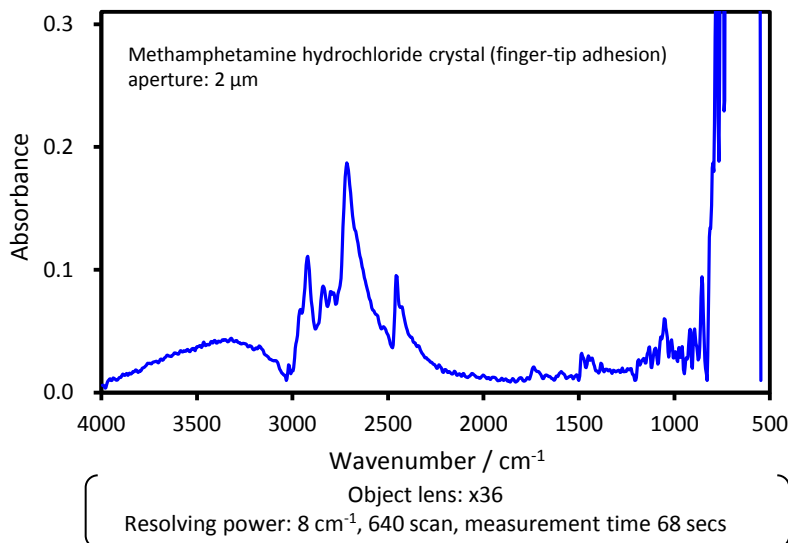
The crystal
appearance
3 microns



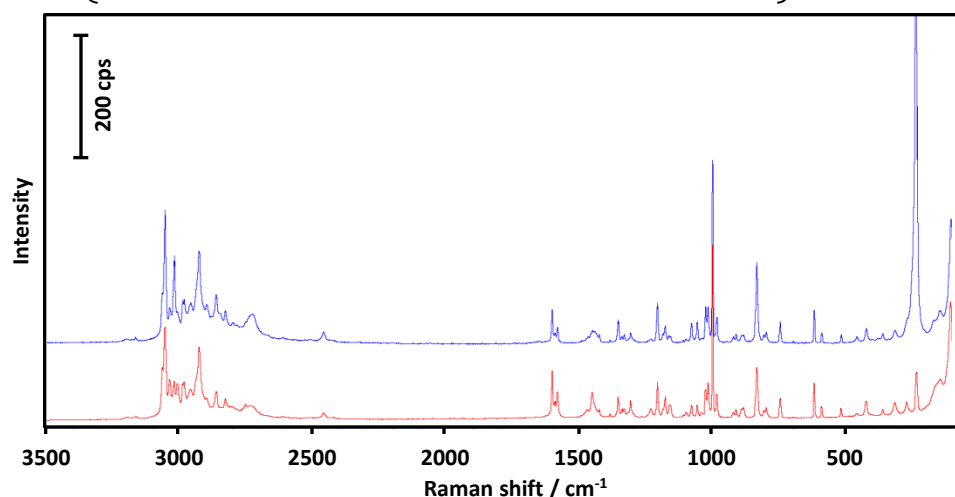
Transmission microscope image
(on BaF_2) SR-IR device @BL431R

2.3 Trace of methamphetamine hydrochloride crystal (Product of Dainippon Sumitomo Pharma Co., Ltd.)

The crystal
appearance
5 microns



Transmission microscope image
(in BaF_2) SR-IR device @ BL43IR



Microscopic Raman spectrum of
trace methamphetamine
hydrochloride crystal (on BaF_2
disc) attached to a finger-tip

Thermo Scientific company
Microscopic DXR laser Raman
Laser wavelength: 532 nm
Beam diameter: 0.7 μm
Measurement time: 128 secs

Methamphetamine hydrochloride
Reference spectrum
(from a database)

Note: Handling and measurements of ephedrine and methamphetamine are done by those who are certified as stimulant and drug researchers.

3. Reference

In other countries, there has been a report that Synchrotron-Radiation-based FTIR spectroscopy took its analysis in less than 30 minutes per sample, and the method served as a extremely powerful tool in more than 200 cases of high-sensitive measurement of post-blast residues (C-4, PETN, TNT, and RDX) (Ref. 1).

Ref.1: A.Banas, et al., *Post-blast detection of traces of explosives by means of Fourier transform infrared spectroscopy*, *Vibrat. Spectrosc.* 51 (2009) 168-176

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