Nano Forensic Science News

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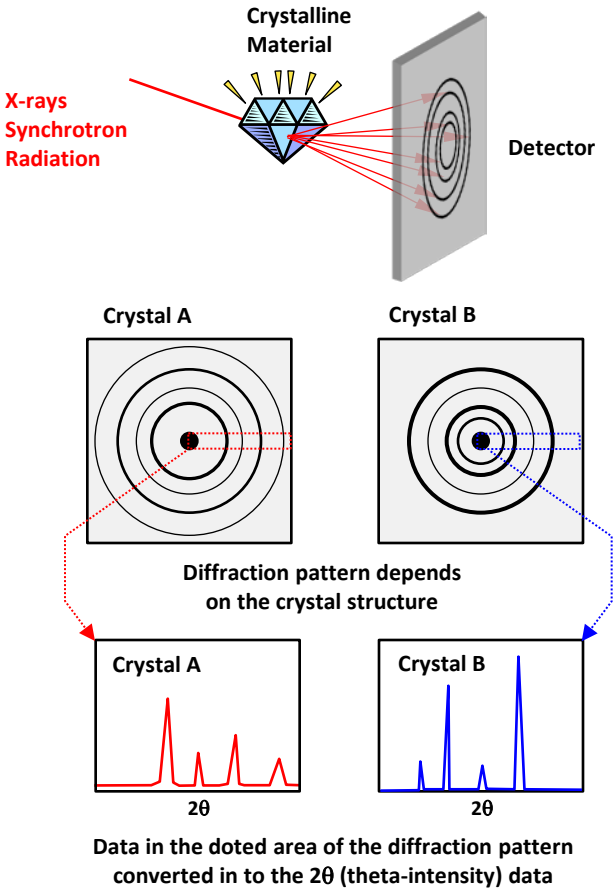
SPring-8 The world's largest third-generation synchrotron radiation facility

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

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

1. Introducing XRD analysis using synchrotron radiation of SPring-8

1.1 Characteristic of the analysis



X-ray diffraction (XRD) analysis is a method to study a material using the physical phenomenon of diffraction that occurs when x-rays hit crystal structures.

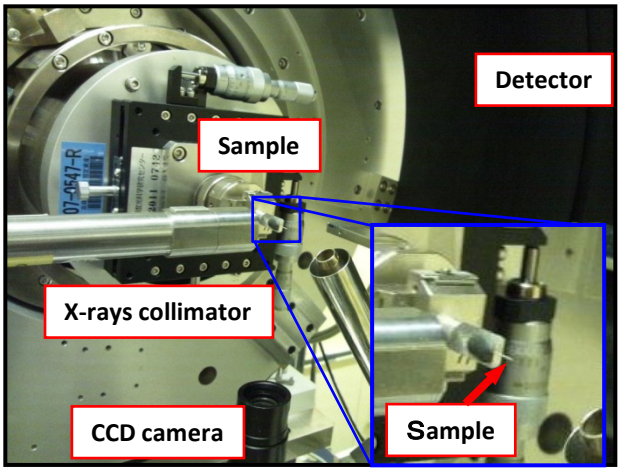
It can be easily and nondestructively determined whether the shining material object is genuine diamond or imitation only by exposing in x-rays.

Historically, the diffraction phenomenon of these x-rays was discovered in 1912 by Max Theodor Felix von Laue, and in 1913, the crystal structure of salt (NaCl) was determined by William and Lawrence Bragg, father and his son using x-ray.

Three of them were awarded the Nobel Prizes for these great achievements in later years.

The essential feature of XRD using synchrotron radiation comparing to conventional XRD is to collect far more high sensitive and clear x-ray diffraction data in shorter time and with tiny amount of samples.

1.2 Overview of BL02B2 beamline at SPring-8



BL02B2 is well-used by researchers from all over the world for their research on power sample using XRD anaysis.

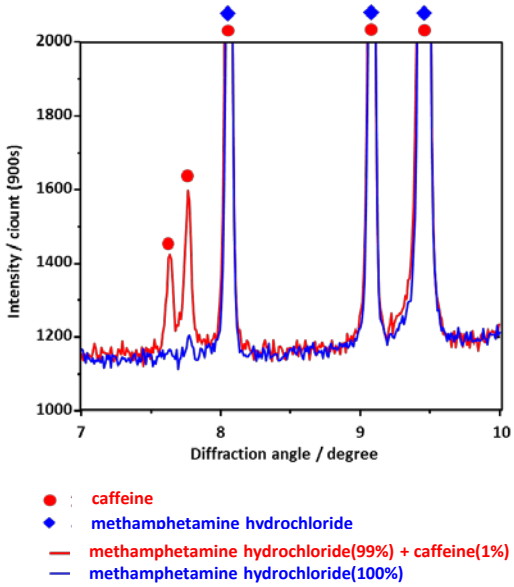
2. XRD analysis on impurities in drugs using synchrotron radiation at SPring-8

It is known that illegal stimulant methamphetamine hydrochlorides contain various kinds of impurities.

XRD analysis using synchrotron radiation is a powerful method for nondestructively determining crystalline impurities in methamphetamine hydrochloride.

Shown below are the examples of XRD analysis on methamphetamine hydrochloride being added in small quantities of different impurities, which are 1) caffeine, 2) pseudoephedrine, one of stimulant raw materials and 3) sodium bromide similar to sodium chloride.

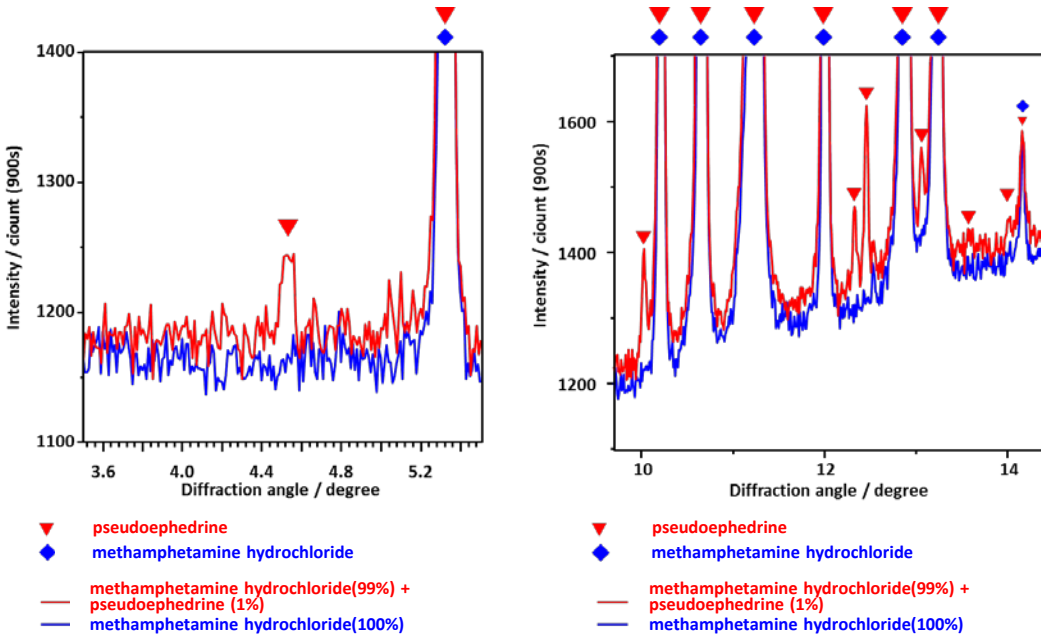
2.1 Detection of 1% Caffeine in methamphetamine hydrochloride (product of Dainippon Sumitomo Pharma Co., Ltd.)



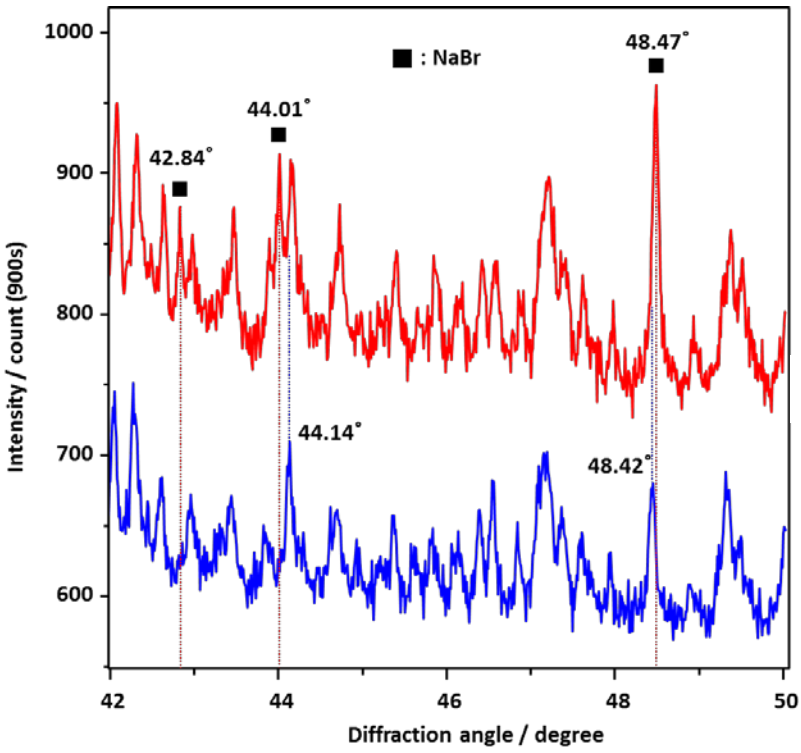
The x-ray diffraction peaks of 1% caffeine (as indicated red "●") contained in methamphetamine hydrochloride are clearly detected in the diffraction pattern of the left-figure.

2.2 Detection of 1% Pseudoephedrine in methamphetamine hydrochloride (product of Dainippon Sumitomo Pharma Co., Ltd.)

The x-ray diffraction peaks (as indicated red "▼") of pseudoephedrine which was slightly added in methamphetamine hydrochloride are clearly shown in the lower figure.



2.3 Detection of 0.5% Sodium bromide in methamphetamine hydrochloride (product made in Dainippon Sumitomo Pharma Co., Ltd.)



The 0.5% of sodium bromide in methamphetamine hydrochloride are clearly depicted in the diffraction pattern as "■" at 2 θ = 42.8, 44.0, and 48.4.

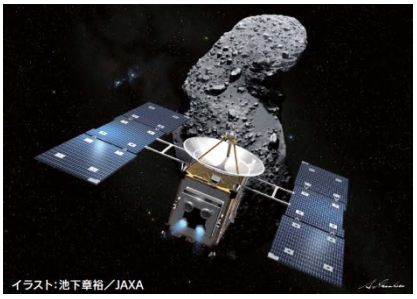
methamphetamine hydrochloride(99.5%) + NaBr (0.5%)

methamphetamine hydrochloride(100%)

3. Reference

Researches conducted at SPring-8 include the analysis of the minute sample the asteroid space craft Hayabusa took home from an asteroid Itokawa, using XRD (BL15XU) and X-rays image analysis (BL47XU).

Itokawa fine particle fixed to a carbon fiber of 5 micron in diameter.



Asteroid space craft Hayabusa (illustration)

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