B131 A Trace Elemental Analysis of Aluminum Flake Particles in Automotive Metallic Paints for Traffic Accident Investigation Using Synchrotron Radiation Micro X-Ray Fluorescence Spectrometry (μ-SR-XRF)

Yoshinori Nishiwaki, Kochi-shi, JAPAN*

Learning Overview: The goal of this presentation is to establish a new method for forensic identification of automotive metallic paint fragments based on trace elements in the aluminum flake particles by μ-SR-XRF.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by revealing that the trace elements in aluminum flake particles obtained by μ-SR-XRF at SPring-8 became new indicators for the discrimination of automotive metallic paint fragments.

Automotive paint fragments are very important samples for traffic accident investigations. In forensic science laboratories in Japan, automotive paint fragments have been analyzed by the following four techniques: optical microscopic observation, microspectrophotometry, Fourier Transform Infrared (FTIR) spectroscopy, and Scanning Electron Microscopy/Energy Dispersive X-ray Spectrometry (SEM/EDS). However, there are cases in which the paint samples cannot be distinguished enough by these analytical methods. On the other hand, metallic pigments are widely used to enhance the designability of cars. It is known that aluminum flakes for automotive metallic pigments have a purity of 99.0% or higher and contain a large variety of trace elements. In this point of view, after shape observation and major element analysis of the aluminum flake particles in automotive paint fragments with SEM/EDS, the trace elemental analysis by μ-SR-XRF was carried out using SPring-8, the world's largest synchrotron radiation facility. This study attempts to discriminate automotive paint fragments by the trace element composition of aluminum flake particles. The goal of this presentation is to establish a new method for forensic identification of automotive metallic paint fragments based on trace elements in the aluminum flake particles by μ-SR-XRF.

Twelve metallic paints obtained from accident vehicles were collected for this research. For measurements of the paint fragment samples, three 0.4mm long by 0.4mm wide fragments, including metallic pigment layers, were separated individually with a scalpel blade. After carbon vapor deposition onto the separated fragments was conducted using carbon coater, SEM/EDS analysis was performed. The μ-SR-XRF analysis was carried out at BL05SS of SPring-8. Since trace elements in the particles could be effectively excited, an incident X-ray beam of 20keV with a size of 2μm x 2μm was prepared by means of the Kirkpatrick-Baez (K-B) mirror system.

Based on the results of SEM/EDS analysis, aluminum (Al), silicon (Si), sulphur (S), and barium (Ba) were detected and the 12 samples were classified into 2 groups: Al-Si type (6 samples) and Al-Si-S-Ba type (6 samples). S and Ba are derived from a pigment dispersant (BaSO4), which can easily and finely disperse aluminum flake particles in reigns of car paints. Many elements, such as Al, Si, S, chlorine (Cl), calcium (Ca), Ba, iron (Fe), copper (Cu), zinc (Zn), gallium (Ga), lead (Pb), strontium (Sr), zirconium (Zr), and niobium (Nb) were detected in the aluminum flake particles by μ-SR-XRF. Ga is generally contained in aluminum alloys because it is the same family element of Al. For that reason, Ga was detected in all aluminum flake particle samples. The aluminum flake particles could be identified with high accuracy by comparing the trace elements. It was found that the trace elements became new indicators for forensic discrimination of automotive metallic paint fragments.

Aluminum Flake Particles, Automotive Metallic Paints, Synchrotron Radiation X-Rays