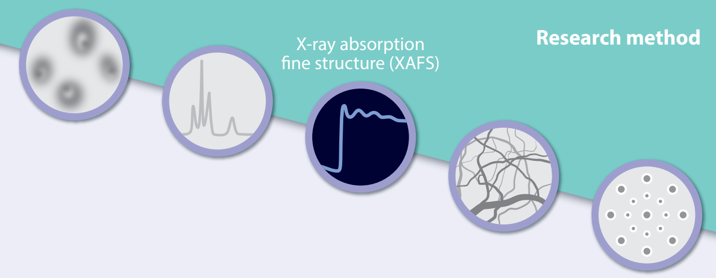
Responding to the Restriction of Hazardous Substances in Electronic Products

Establishment of high-sensitivity nondestructive inspection method for hexavalent chromium



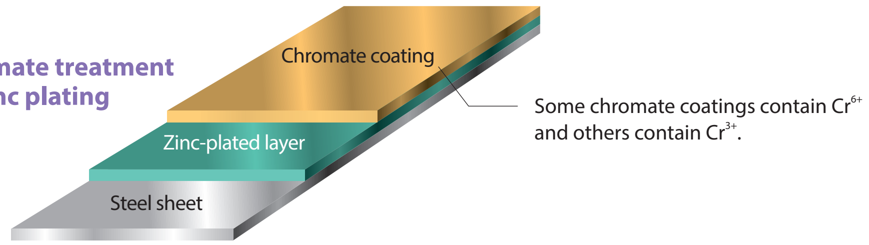
Achievements

- Development of a high-sensitivity nondestructive method for measuring the amount of hazardous **hexavalent chromium** in **chromate coatings*** used for protecting electronic products from corrosion
- Realization of a high-reliability rapid measurement method replacing the conventional inspection method involving melting
- Application of the developed method to satisfy the regulations imposed by the EU (**RoHS directive**)**

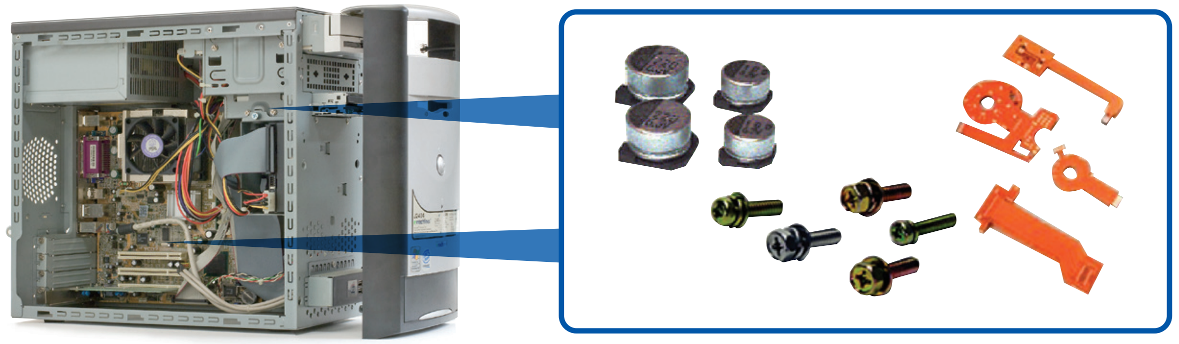
R&D facility: Fujitsu Laboratories, Ltd.

***Chromate coatings** are used for protecting iron and aluminum from corrosion. Some contain hexavalent chromium (Cr^{6+}) and others contain trivalent chromium (Cr^{3+}). Chromate coatings containing Cr^{6+} include yellow and black chromates and iridite. Cr^{6+} is a hazardous substance and causes diseases such as skin ulcers, nasal septum perforation, and lung cancer, and hence, the use of Cr^{6+} has started to be regulated. Cr^{3+}, less hazardous to human bodies than Cr^{6+}, has been studied for use in chromate coatings instead of Cr^{6+}.
****Restriction of Hazardous Substances (RoHS) directive:** a standard established by the European Union (EU) to regulate the use of specified hazardous substances in electric/electronic products, enforced in July 2006. The sale of products that do not conform to the RoHS directive is banned in the EU. Cr^{6+} is included in the list of regulated substances.

Chromate treatment for zinc plating



Iron and aluminum in electronic components are given a corrosion-proof coating.



Role of SPring-8

Background

Measures to abolish the use of Cr^{6+} are being increasingly carried out because of the damage to human bodies caused by Cr^{6+} contained in electronic products and the environmental pollution due to the disposal of electronic products. Yet there has been no substantially reliable method of measuring the amount of Cr^{6+} through chemical treatment. What we need is a **nondestructive analytical method of detecting Cr^{6+}.**

In the method of analyzing Cr^{6+} through chemical treatment, Cr^{6+} is extracted by dissolving a chromate coating in unheated or hot water. In line with this, the following problems occur. The valency of Cr^{6+} changes during extraction, Cr^{6+} reacts with coexisting elements, and precise analysis is difficult for insoluble coatings. These result in unsatisfactory reliability.

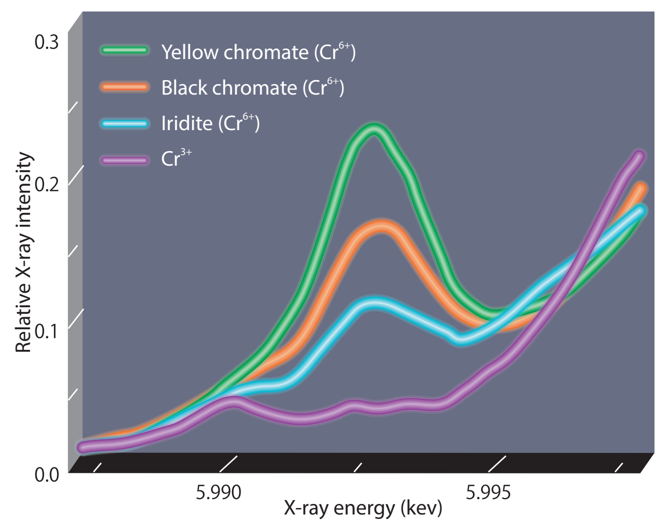
Results

The SPring-8 XAFS method is appropriate for nondestructively measuring the absolute amounts of trace elements contained in samples. When Cr compounds were measured by the XAFS method, Cr^{6+} and Cr^{3+} were observed to be clearly separated in the absorption spectra. We measured and clarified the **absolute amount of Cr^{6+} (content rate)** for various chromate coatings by the XAFS method.

Moreover, it has become possible to obtain the depth distribution of Cr^{6+} in chromate coatings from the dependence of X-ray injection angle in the XAFS result. Thus, the technology for directly analyzing Cr^{6+} in chromate coatings without chemical treatment was improved.

Measurement result for chromate by XAFS

The peak at 5.993 keV in the absorption spectrum for each chromate corresponds to Cr^{6+}. No peak is observed for Cr^{3+}. Thus, the content rate of Cr^{6+} can be measured.



Content rate of Cr^{6+} in each chromate

The content rate of Cr^{6+} is calculated from the XAFS spectra in the figure to the left.