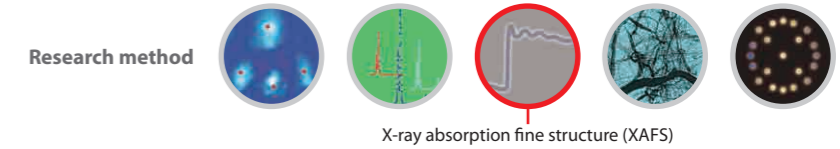


# Responding to the Restriction of Hazardous Substances in Electronic Products

Establishment of high-sensitivity nondestructive inspection method for hexavalent chromium



Beamline used at SPring-8: Sunbeam BM (BL16B2)

## 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 ( $\text{Cr}^{6+}$ ) and others contain trivalent chromium ( $\text{Cr}^{3+}$ ). Chromate coatings containing  $\text{Cr}^{6+}$  include yellow and black chromates and iridite.  $\text{Cr}^{6+}$  is a hazardous substance and causes diseases such as skin ulcers, nasal septum perforation, and lung cancer, and hence, the use of  $\text{Cr}^{6+}$  has started to be regulated.  $\text{Cr}^{3+}$ , less hazardous to human bodies than  $\text{Cr}^{6+}$ , has been studied for use in chromate coatings instead of  $\text{Cr}^{6+}$ .

\*\***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.  $\text{Cr}^{6+}$  is included in the list of regulated substances.

## Role of SPring-8

### Background

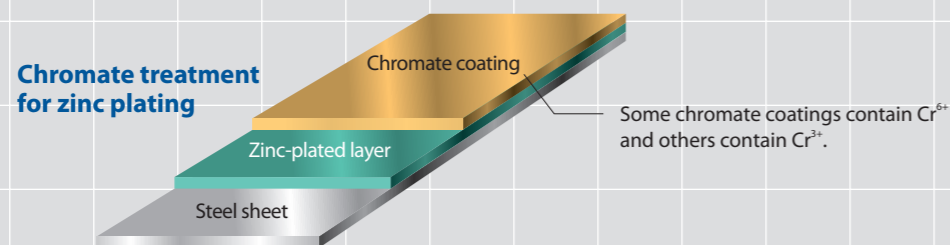
Measures to abolish the use of  $\text{Cr}^{6+}$  are being increasingly carried out because of the damage to human bodies caused by  $\text{Cr}^{6+}$  contained in electronic products and the environmental pollution due to the disposal of electronic products. Yet there has been no substantially reliable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

In the method of analyzing  $\text{Cr}^{6+}$  through chemical treatment,  $\text{Cr}^{6+}$  is extracted by dissolving a chromate coating in unheated or hot water. In line with this, the following problems occur. The valency of  $\text{Cr}^{6+}$  changes during extraction,  $\text{Cr}^{6+}$  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,  $\text{Cr}^{6+}$  and  $\text{Cr}^{3+}$  were observed to be clearly separated in the absorption spectra. We measured and clarified the **absolute amount of  $\text{Cr}^{6+}$  (content rate)** for various chromate coatings by the XAFS method.

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

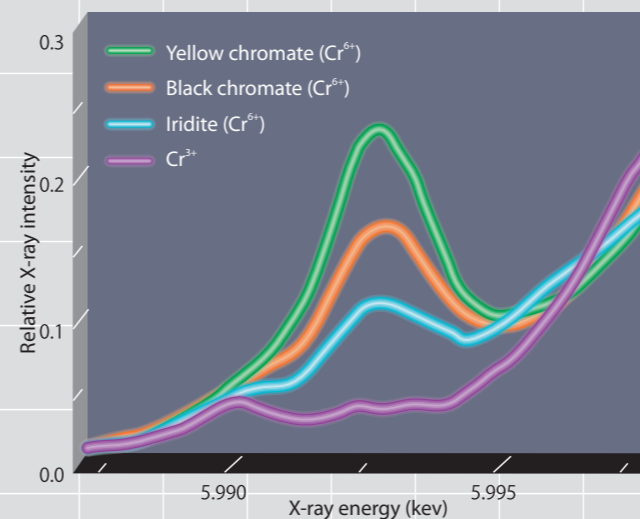


Iron and aluminum in electronic components are given a corrosion-proof coating.



### Measurement result for chromate by XAFS

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



### Content rate of $\text{Cr}^{6+}$ in each chromate

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

