

Application News

Energy Dispersive X-ray Fluorescence Spectrometer EDX-8100

Analysis of Fluorine by EDXRF —A Simple Check for PFAS in Electrical and Electronic Components

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User Benefits

- ◆ EDXRF analyzes halogens (F, Cl, Br, and I) more easily than absorption/emission methods.
- ◆ Fluorine (F) on the material surface is detected directly, without sample preparation.
- ◆ Simultaneous halogen analysis enables simple screening for the possible use of halogenated flame retardants.

■ Introduction

As regulations on PFAS and halogenated organic flame retardants tighten in the EU^{(1),(2)} and some U.S. states^{(3),(4)}, there is a growing need to identify at an early stage whether halogens such as fluorine are present in electrical and electronic materials. Rapid supply-chain screening is also increasingly required.

The energy dispersive X-ray fluorescence spectrometer EDX-8100 requires little to no sample preparation and can quickly and easily detect halogens such as fluorine (F), chlorine (Cl), and bromine (Br). EDX-8100 quickly shows whether these halogens are present, helping narrow down regulated products and prioritize samples for detailed analysis.

This article demonstrates the usefulness of halogen detection by EDXRF using an ETFE-coated wire and a relay as examples.

1), 2) In the electronics and semiconductor sectors under PFAS regulations, polymeric PFAS such as PTFE are also under consideration, with measures including a 13.5-year derogation period after entry into force (as of May 2026).

3), 4) Under the Washington Administrative Code regarding organic flame retardants, intentional addition is assumed for plastic external housings of electrical and electronic products when the total bromine, total chlorine, and total fluorine content exceeds 1000 ppm. Related screening analysis by X-ray fluorescence spectrometry is also referenced.

1. Wire-Coating Resin

■ Sample Materials

ETFE-coated wire

■ Sample Preparation

The sample was measured directly in the bundled state. Fig. 1 shows an image of the sample taken with the instrument's built-in sample observation camera.

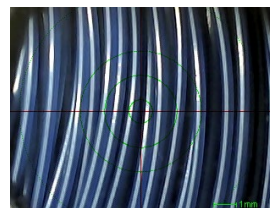


Fig. 1 ETFE-Coated Wire

■ Qualitative/Quantitative Analysis

Fig. 2 and Table 1 show the qualitative and quantitative results. Fluorine, the main constituent of ETFE (ethylene tetrafluoroethylene), was strongly detected. By the FP method, the material ETFE was quantified assuming a composition of $C_4H_2F_4$. Since wire components such as Cu and Sn were also detected, values should be treated as reference values for a composite product.

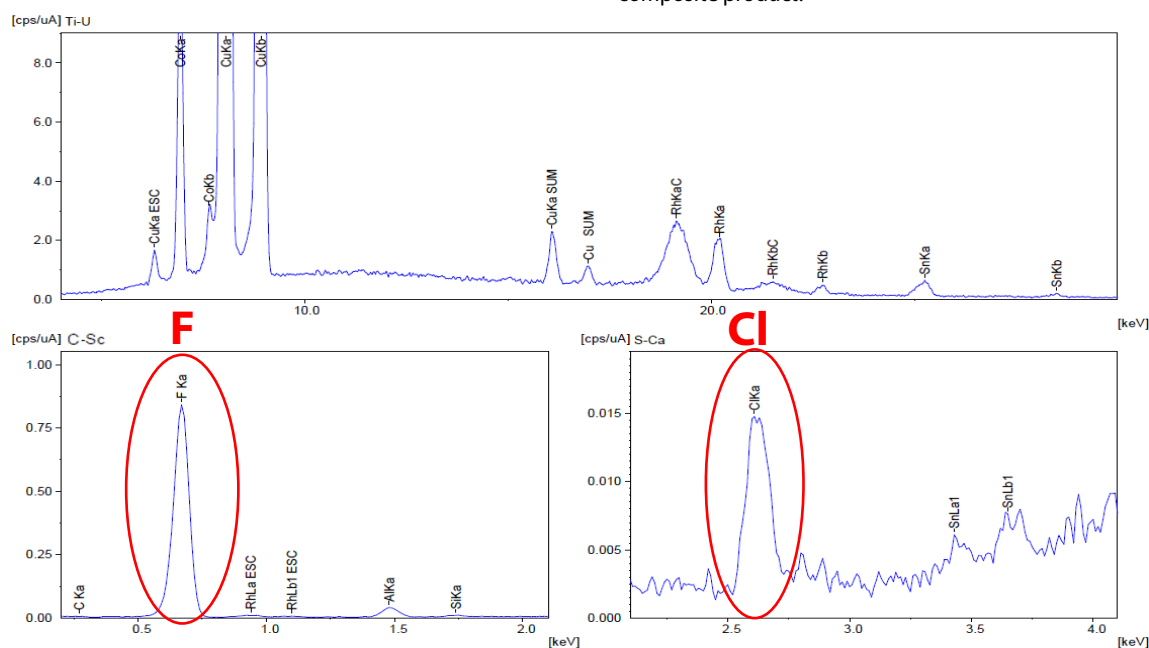


Fig. 2 Qualitative Analysis Results for ETFE-Coated Wire

Table 1 Quantitative Analysis Results for ETFE-Coated Wire (For Reference Only) [wt%]

Sample	C ₄ H ₄ F ₄	Cl	Cu ⁺	Co	Al	Sn ⁺	Si
ETFE-coated wire	95.01	0.13	4.59	0.12	0.096	0.053	0.009

*1 Cu and Sn are presumed to be components of the wire.

2. Electrical Component

■ Sample Materials

Relay

Fig. 3 shows an image of the sample.



Fig. 3 Relay

■ Sample Preparation

The sample was measured directly.

■ Qualitative/Quantitative Analysis

Fig. 4 and Table 2 show the qualitative and quantitative results. On the relay surface, F, Br, and Sb were detected, suggesting the possible presence of fluorine-containing materials (release agents, coatings, anti-dripping agents, etc.), brominated flame retardants, and flame-retardant synergists. Other elements such as Cu and Fe, likely derived from internal components of the relay, were also detected, so values should be treated as reference values for a composite product.

■ Analytical Conditions

Table 3 lists the analytical conditions used for the ETFE-coated wire and relay. For measuring F, the C-Sc channel integration time is as short as 60 seconds, enabling rapid measurement.

Table 3 Analytical Conditions

Measurement channel	Ti-U	C-Sc	S-Ca
Analysis line	K α , K β , L α , L β , ...		
X-ray tube	Rh target		
Tube voltage	50 kV	15 kV	
Tube current	Automatic control		
Collimator	10 mm ϕ		
Integration time	20 s	60 s	20 s
Dead time	Max. 30 %		
Filter	None		#2
Detector	SDD semiconductor detector		
Atmosphere	Vacuum		
Quantitative analysis method	FP method		

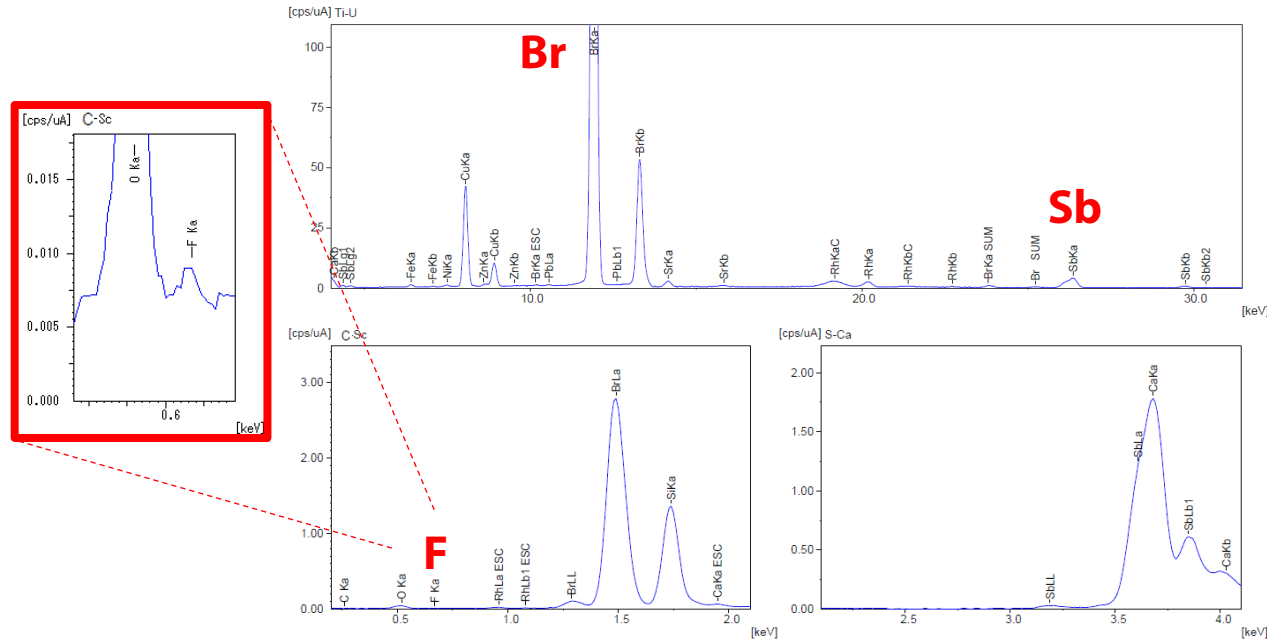


Fig. 4 Qualitative Analysis Results for Relay

Table 2 Quantitative Analysis Results for Relay (For Reference Only) [wt%]

Sample	F	Br	Sb	Ca	Si	Cu	Sr	Fe	Pb	Ni	Zn	C ₁₂ H ₁₂ O ₄ *1
Relay	0.35	1.93	1.23	1.63	1.21	0.31	0.017	0.014	0.008	0.006	0.005	93.29

*1 The organic fraction was quantified by setting C₁₂H₁₂O₄ as the balance (residual amount).

■ Conclusion

As shown above, fluorine can be detected and quantified rapidly and easily when its content is about 0.1 wt% or higher. In addition to intentional use, the presence of fluorine compounds can also be confirmed in cases of unintentional inclusion, such as transfer or contamination.

In the electrical and electronics field, demand for analysis related to PFAS and halogenated flame retardants is expected to increase in the future, and EDXRF is useful as a simple initial screening method.

* Here, PFAS denotes organofluorine compounds.

Note that EDXRF cannot identify the compound type.

* For regulatory details, please refer to the latest official publications.

This article focuses only on analytical considerations.

References

- 1) European Chemicals Agency (ECHA), "[Submitted restrictions under consideration](#)," ECHA.
- 2) [ECHA PACT RAC sector evaluation: Electronics and Semiconductors](#).
- 3) Washington State Legislature, "[Chapter 173-337 WAC: Safer Products Restrictions and Reporting](#)," Washington Administrative Code.
- 4) Washington State Department of Ecology, "[Resource for Complying with the Safer Products for Washington Rule: Electric and Electronic Products](#)."

Related Applications

1. Analysis of Fluorine by EDXRF: Simple Check for Use of PFAS for Textile and Kitchen Supplies, [Application News No. 01-00975-EN](#)



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