

Application News

Energy Dispersive X-ray Fluorescence Spectrometer EDX-7200

Identification of Virgin PET and Recycled PET by X-ray Fluorescence Spectrometry

Xu Yan

User Benefits

- ◆ EDX enables the identification of recycled PET.
- ◆ Measurements are quick and simple, require no cumbersome pretreatment, and can be automated using a multi-sample turret.
- ◆ The instrument offers excellent cost-performance and supports the detection of a wide range of elements.

■ Introduction

Establishing a sustainable circular economy is a major societal challenge, and recycling plastic materials such as PET (polyethylene terephthalate) plays a particularly important role in reducing environmental impact. Large numbers of PET bottles and molded products are used every day in the food and beverage sectors. To recycle these materials safely and reliably, technologies are required that can accurately identify their origin. In practice, however, appearance and conventional physical properties alone are insufficient to distinguish virgin material from recycled material, creating a need for a more reliable identification method.

For rapid identification in industrial settings, a method requiring little or no pretreatment is highly desirable. In some cases, non-destructive analysis is also needed to enable subsequent application of other analytical techniques. This article presents a practical approach in which metal catalysts present in PET are detected by EDX (Energy-Dispersive X-ray Spectroscopy) and used to distinguish material-recycled PET from virgin PET.

■ Principle and Overview

Metal catalysts such as antimony (Sb) and germanium (Ge) are used in the synthesis of PET resin. These catalyst metals have been reported to be useful indicators of material origin.^{1),2)} For example, Sb and Ge are frequently detected together in material-recycled PET, whereas only one catalyst metal is detected in chemically recycled PET and virgin PET. This likely reflects the fact that material-recycled PET is derived from a mixture of feedstocks using different catalysts.

ICP-AES (ICP optical emission spectrometry) and ICP-MS (ICP mass spectrometry), which are commonly applied to catalyst metal analysis, provide high sensitivity and accuracy. However, they require pretreatment to convert the sample into a solution, thereby lengthening the analytical workflow. By contrast, EDX can measure solid samples directly, making it well-suited to applications requiring rapid results, such as incoming material inspection and in-line analysis in molding plants. Because EDX is non-destructive, it is also suitable for multimodal analytical workflows.

On the other hand, some commercially available handheld EDX instruments do not support elements such as Sb and Ge. At the same time, higher-end systems may not offer the specifications or price range needed for industrial deployment. The EDX-7200 supports a broad range of elements with excellent cost performance. This article describes the analysis of Sb and Ge in PET using this instrument.

■ Samples

- Virgin PET fiber: 1 sample
- Recycled PET fiber (material recycling): 1 sample

Fig. 1 shows the samples. JIS testing showed that the two samples had nearly identical tensile strength.



Fig. 1 Recycled PET Fiber (Left) and Virgin PET Fiber (Right)

■ Results

Samples were placed in sample cups, sealed with 5 μ m polypropylene film, and measured directly. An EDX-7200 instrument (Fig. 2) was used. The two samples were analyzed sequentially using the optional turret unit. Fig. 3 shows the samples mounted on the turret.



Fig. 2 EDX-7200



Fig. 3 Samples Mounted on the Turret

Fig. 4 overlays the profiles obtained from the two samples, and Table 1 summarizes the quantitative results of Ge and Sb calculated by the FP (Fundamental Parameter) method using the automatic balance function.

For the virgin PET fiber, Sb was detected, whereas Ge was not. In contrast, both Sb and Ge were detected in the recycled PET fiber. These results are consistent with previous reports and confirm that EDX can effectively distinguish recycled PET from virgin PET.

Table 1 Quantitative Results

	Ge (ppm)	Sb (ppm)
Virgin PET Fiber	-	87.8
Recycled PET Fiber	19.3	92.2

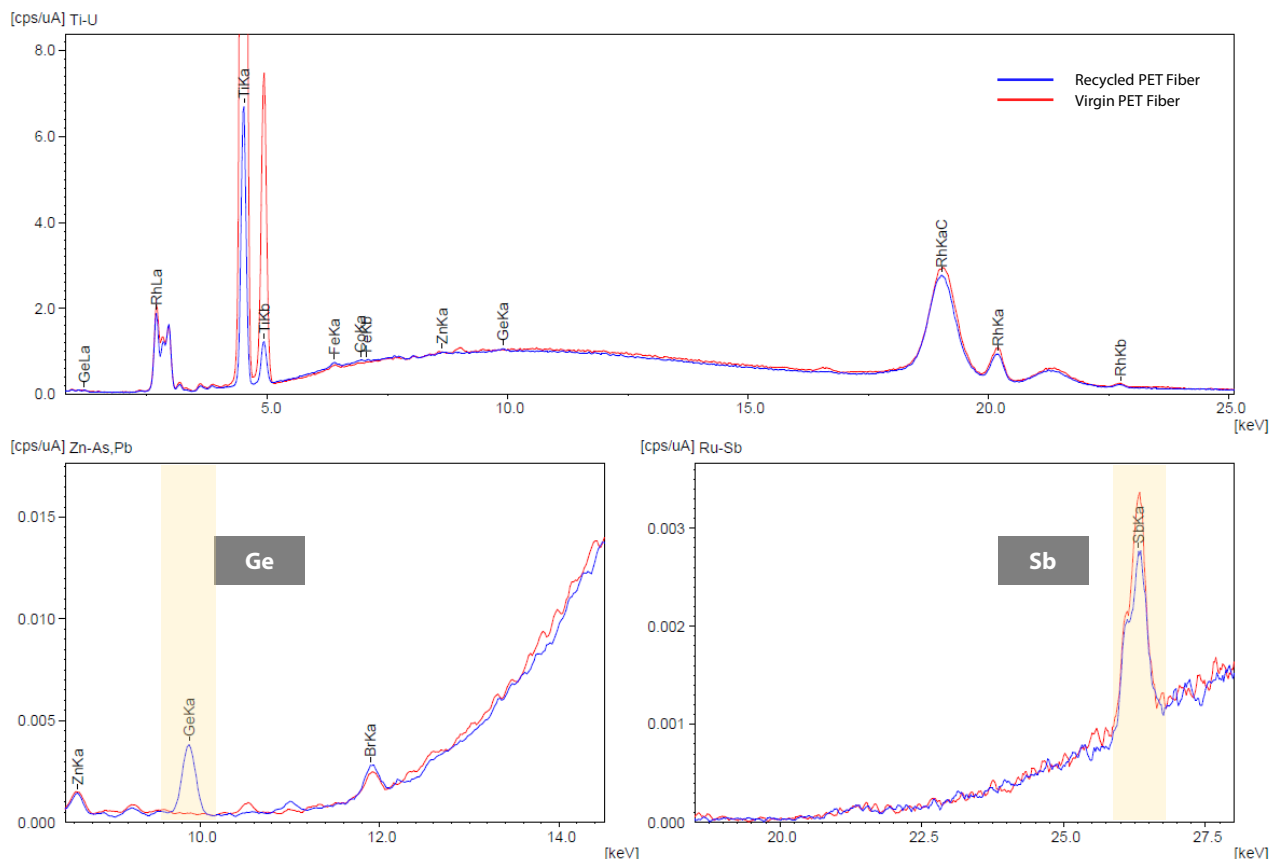


Fig. 4 Overlaid Profiles of Virgin and Recycled PET Fibers

Analytical Conditions

Table 2 summarizes the analytical conditions.

Table 2 Analytical Conditions

Method	FP Method		
Elements	Ti-U	Zn-As, Pb	Ru-Sb
Detector	SDD		
X-ray tube	Rh target		
Collimator diameter	10 mm		
Tube voltage	50 kV	50 kV	50 kV
Tube current	Auto		
Primary filter	None	#4	#1
Atmosphere	Air		
Integration time	20 s	60 s	60 s
Dead time	Max. 30 %		

Conclusion

EDX enables rapid and straightforward elemental analysis without cumbersome sample pretreatment. Previous studies have shown that the presence of Sb and Ge can be used to identify recycled PET. Building on this concept, this article presents a practical analytical approach based on EDX. Using the EDX-7200, which combines broad elemental coverage with excellent cost performance, the proposed method provides a practical tool for rapid on-site identification, quality control, and traceability management. When combined with physical property data and other information, this approach is expected to contribute to the safety assessment and quality assurance of recycled materials, thereby supporting a more advanced circular economy.

Acknowledgments

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References

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- Ministry of the Environment, Section 4.8, Guidance on investigation methods for products containing recycled plastics (by resin type), Document No. 000040692; Polyethylene terephthalate (PET) fibers.

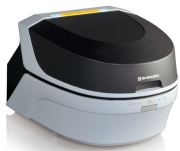
Related Applications

- Thermal Characterization of Virgin and Recycled PET, [Application News No. 01-01011-EN](#)

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Some products may be updated to newer models.



➤ EDX-7200

Energy Dispersive X-ray Fluorescence Spectrometer

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