XRF

Find a FKM Black O-ring via Fluorine Detection using HORIBA's micro-XRF XGT-9000

Application Note

Materials XGT46

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Abstract: Rubber O-rings are widely used to seal and join components. Materials are selected based on performance needs. Choosing the wrong material can cause leakage or process/product failure. In this application note, we demonstrated HORIBA's XGT-9000 micro-XRF as a non-destructive tool to help differentiate rubber O-rings.

Keywords: Black rubber O-ring identification, elemental analysis, micro-XRF

Introduction

Rubber O-rings are widely used to seal and join components in various industries. Materials such as EPDM, NBR, silicone, and FKM are selected based on performance needs. Choosing the wrong material can cause leakage or process/product failure.

Visual identification is the simplest method, but it is difficult when O-rings have similar colors. FT-IR can identify organic structure, but carbon black in black O-rings absorbs broadly in the IR and increases the sample's refractive index, which distorts the baseline and peak shapes and makes it challenging to obtain reliable results.

This application note introduces HORIBA's XGT-9000 Micro-XRF Analytical Microscope as a non-destructive tool to help differentiate rubber O-rings.

The XGT-9000 X-ray Analytical Microscope

X-ray fluorescence (XRF) is a non-destructive method for elemental identification. Although it cannot identify organic structures, XRF supports O-ring analysis by showing elements such as fluorine in FKM, silicon in silicone rubbers, and other inorganic additives, regardless of sample color. HORIBA's XGT-9000 micro-XRF instrument features a micro-focused beam and is useful for analyzing small areas on skinny O-rings.

Key Features

- Micro-focused beam without compromising the balance of the beam intensity and spatial resolution.
- High resolution CMOS camera for precise observation to hit a surface of a skinny O-ring.
- Detector capable of detection of elements with atomic numbers Z < 11 such as C, O, F in rubber O-rings.
- Detachable holder for easy sample setting.

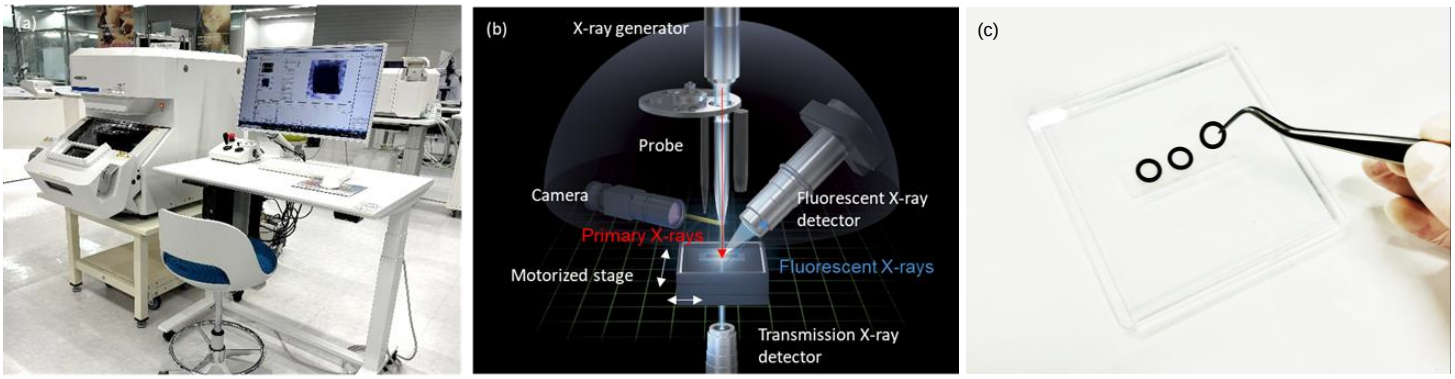

Figure 1. (a) HORIBA XGT-9000 X-ray Analytical Microscope; (b) Schematic diagram of the internal optics; (c) Sample setting on a sample tray.

Sample information & Measurement

We prepared four different black O-rings (EPDM, NBR, silicone, and FKM) that are commercially available. We acquired XRF spectra at three different positions on each O-ring using the XGT-9000 Expert under full vacuum condition for detection of lighter elements. We selected a 100 µm ultra-high intensity probe and with 15 kV voltage and auto current at the primary X-ray generator, with the measurement time of 60 seconds per spectrum.

Result

Figure 2 shows an optical image of one analysis position and overlaid spectra for each O-ring. While the base rubber molecular structure cannot be identified by XRF, different inorganic additives were detected between EPDM and NBR. Also, clear Si and F peaks were observed in the silicone and FKM O-rings, respectively. Thus, these results show the HORIBA XGT-9000 can identify the FKM O-ring non-destructively via fluorine detection.

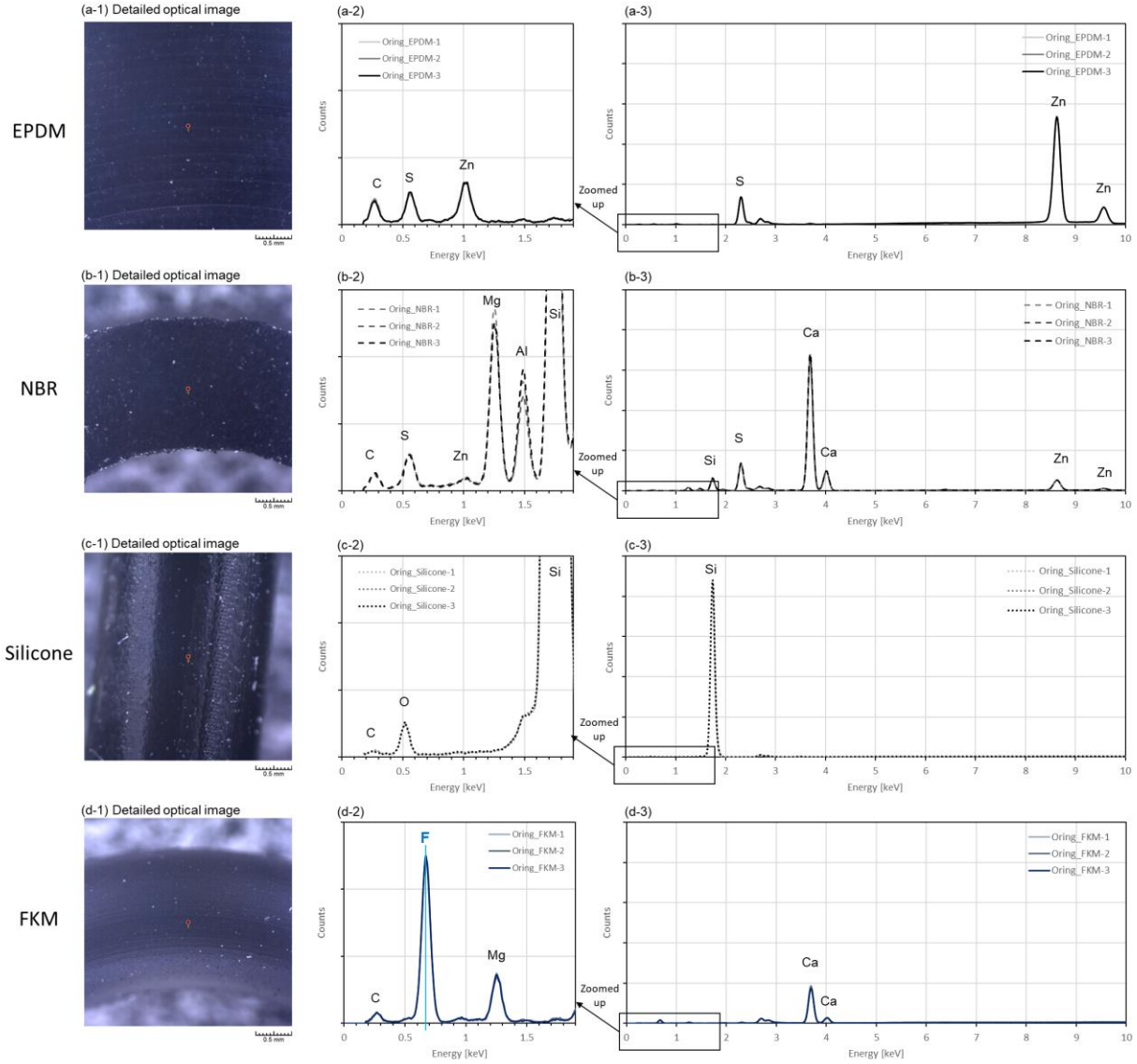

Figure 2. Detailed optical images of one analysis position and overlaid spectra for individual O-rings ((a) an EPDM O-ring; (b) a NBR O-ring; (c) a silicone O-ring; (d) a FKM O-ring).

Abbreviation: EPDM: Ethylene Propylene Diene Monomer, NBR: Nitrile Butadiene Rubber, FKM: Fluorkautschukmaterial.

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