

**See the Forest, See the Trees! Series**  
Leveraging the Strength of X-ray Fluorescence and Scanning Electron Microscope

# Analysis of Discolored Glass in a Time-Lag Fuse



A time-lag fuse can withstand short-duration over-currents, such as inrush current, and if the over-current persists, it breaks in the same manner as a regular fuse. JEOL analyzed the deterioration of the time-lag fuse from both **macro-** and **micro-**level perspectives.



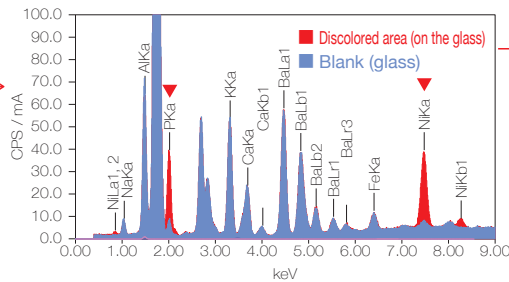
X-ray Fluorescence Analysis (XRF): JSX-1000S



Scanning Electron Microscope (SEM): JCM-7000/JSM-IT510

## What elements are present?

Elemental analysis and quantification using XRF

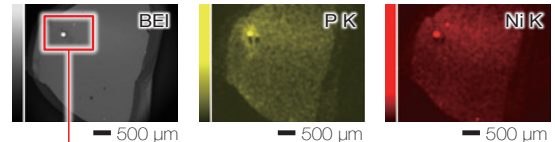


- It was confirmed that the elements present in the discolored area are **Ni** and **P**.
- The elements are quantified using the FP method.

Amount of deposited material mg/cm <sup>2</sup>	Ni mass%	P mass%
0.017	80.8	19.2

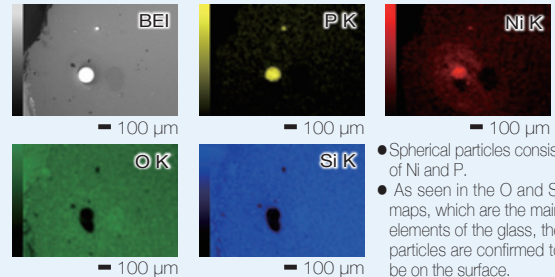
## Distribution map of Ni and P

SEM confirmation of elemental distribution in micro areas



It was confirmed that the distribution of Ni and P is **non-uniform**

## Mapping spherical deposits at higher magnification

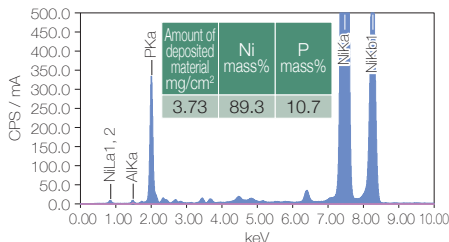
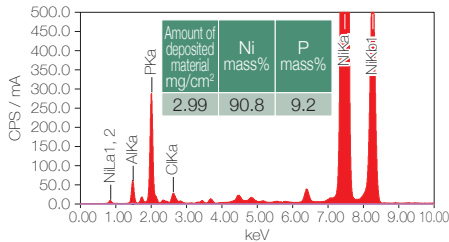


- Spherical particles consist of Ni and P.
- As seen in the O and Si maps, which are the main elements of the glass, the particles are confirmed to be on the surface.

## What changes before and after use?

Comparison of elemental analysis and amount of deposited material

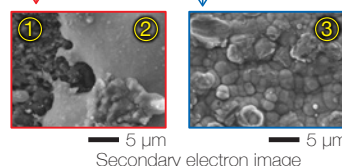
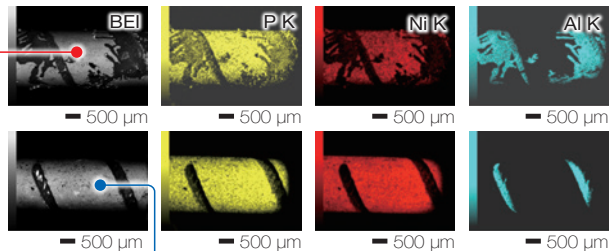
### [2] Fuse Elements



- When the fuse element is used, the Ni and P coating peels off, and the underlying aluminum becomes detectable.
- Since the Ni and P coating peels off, the deposited amount decreases.

## Maps before and after use of the fuse element and surface observation using secondary electron images

Comparison of element distribution



- By comparing against the map before use, we confirmed that the distribution of Ni and P is different.

- Exposed Al on the surface
- Solidified Ni and P deposits
- Ni and P coated surface before use

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