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Comprehension of EPMA Area Mapping Analysis

Y.H. Jung[1], B.O. Yoo, H.M. Kim and S.B. Ahn
Irradiated Materials Examination Facility, Korea Atomic Energy Research Institute,
Deokjin-dong, Yuseong-gu, Daejeon, 305-353, Korea
*Corresponding author. E-mail : nyhjung@kaeri.re.kr

1. Introduction to EPMA

An electron probe micro-analyzer (EPMA) is a micro beam instrument used primarily for the non-destructive chemical analysis of solid samples. EPMA is also informally called an electron microprobe, or just probe. It is fundamentally the same as an SEM, with the added capability of chemical analysis. EPMA works by bombarding a micro-volume of a sample with a focused electron beam and collecting the X-ray photons thereby emitted by the various elemental species. Because the wavelengths of these X-rays are characteristic of the emitting species, the sample composition can be easily identified by recording WDS spectra WDS spectrometers are based on the Bragg's law and use various moveable, shaped mono-crystals.

EPMA instruments are possible to widely in post-irradiation examinations for analysis of fuels and materials characterization adding shielding materials modification. Shielded EPMA in IMEF-KAERI is used for observing image, components analysis, description of specific elements, identification of defected specimens. Many researchers are confusing of the WDS and EDS. Also, sometimes they are misunderstanding the results of EPMA. This study is described understanding of area mapping analysis results by Shielded EPMA.

2. Understanding Area mapping analysis

To understand area mapping analysis, we had better know about WDS(wave length dispersive spectrometer) function of EPMA. When an electron beam of sufficient energy interacts with a sample target it generates X-rays, as well as derivative electrons. A wavelength-dispersive spectrometer uses the characteristic X-rays generated by individual elements to enable quantitative analyses to be measured at spot sizes as small as a few micrometers (e.g. Fig. 1). WDS can also be used to create element X-ray compositional maps over a broader area. Together, these capabilities provide fundamental quantitative compositional information for a wide variety of solid materials.

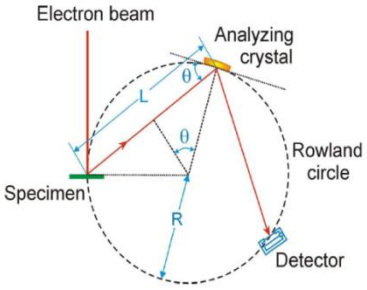

Figure 1 Schematic of WDS

Figure 2 Shows WDS scan by LIF x-tal which results of abilities of LIF crystals on the heavy metal. It means the abilities of x-tal is quietly different depend of x-tal types. Area image mapping analysis is within a given sample, once the x-ray intensities of each element of interest are "x-ray counted" in a detector at a specific beam current, the count rates are compared to those of counting known values of the elements.

Figure 3 Shows result of U-Mo fuel area mapping by WDS stage scan. As shown in Figure 3, the measurement method for a particular element is the result of collecting the results by applying the application condition under certain conditions after the crystal was fixed to afford the desired element. However, many researchers confusion with respect to how to interpret the results of various colors appeared in the picture at a constant value that is often misjudged as a wt% having a specific element. In the case of the Xe picture next to it but can likewise appeared as the composition of the wt% level, only the composition of the actual content is only a few ppm. The results appear in the picture as well as one should know that the distribution and relative ratio of each element has no real relevance and composition. That this result is not mean to say that the distribution of the absolute composition look shown in Figure the relative proportions.

Figure 4 shows the WDS analysis conducted by the carbon content of the VHTR irradiated fuel by area mapping technique As shown in the figure can discern the concentration of carbon relative to the color. In addition, the results can be analyzed to determine the concentration in Profile technique. Using this result can be compared to the

concentration of a particular position relative to the ratio. But is not means that can be quantified as an absolute value.

Figure 5 shows the results of quantitative analysis for the boundary portion of the irradiated nuclear fuel. Such sites, but can use the mapping analysis using the Area WDS scan, the results are only be viewed as a relative color as already described.

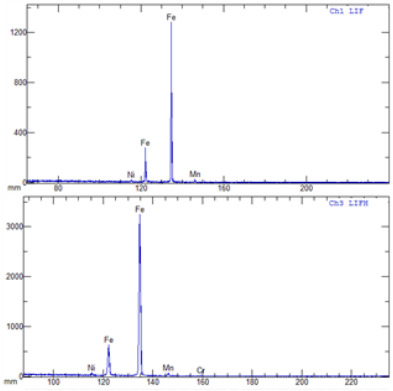

Figure 2 WDS scan by LIF, LIFh x-tal

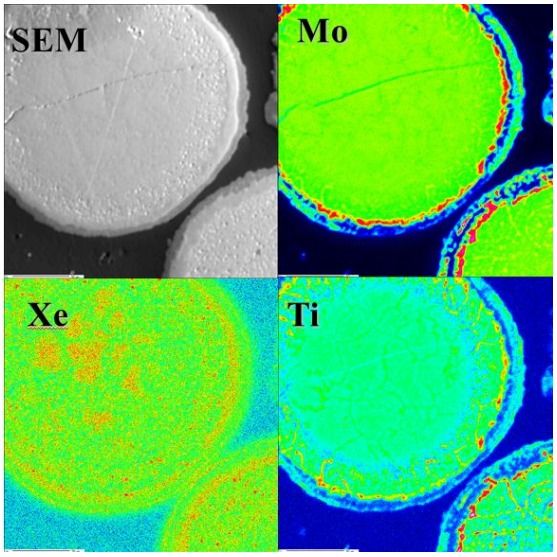

Figure 3 U-Mo fuel area mapping

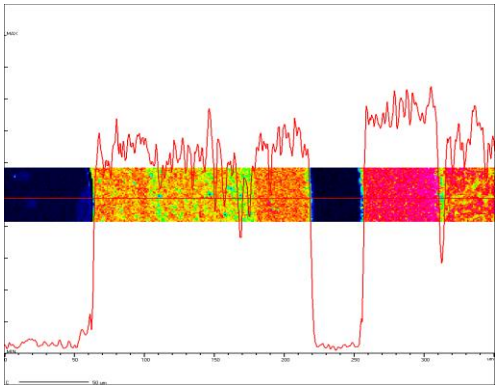

Figure 4 VHTR fuel area mapping

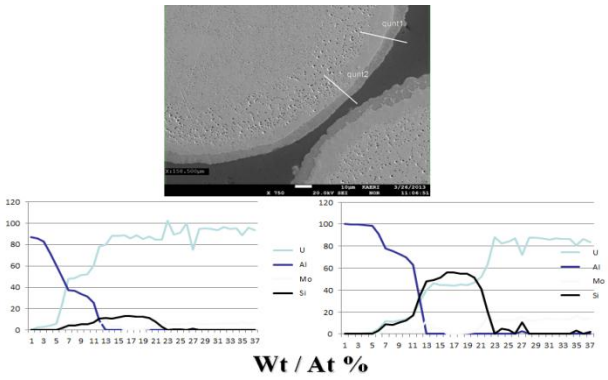

Figure 5 Quantitative analysis results by EPMA

3. Results

EPMA provides much better results than standard SEM/EDS systems. Because of the internal properties of WDS, the general sensitivity, analysis of light elements and risks of erroneous interpretation of qualitative spectra are all superior with EPMA. Spectral resolution and detector dead time are much better than EDS (Energy Dispersive Spectroscopy). Many researchers are struggling to understand the EPMA analysis results. Especially more so in the Area mapping analysis results analysis using by WDS scan method. In order to avoid this confusion we had better understand the structure and function of WDS and EPMA. This paper describes how to comprehension and understand the results of WDS scan results which are difficult to understand in EPMA analysis results.