

Improvement in Macroscopic Image Analysis Technique of PIE Specimens Using a Multi-Magnification Periscope

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1. Introduction

PIEF(Post Irradiation Examination Facility) in KAERI has the macroscopic image analysis equipment which can observe the macroscopic images of PIE specimens using Polaroid film in the lead cell. It has been used to provide the macroscopic images of PIE specimens and to inspect a surface condition of mounted PIE specimens in low magnification. But this equipment has a limit to show the image of the only mounted specimen and also has been degraded due to the moisture and radiation. Therefore, a unity magnification periscope with CCD camera was installed for the macroscopic image analysis of PIE specimens in the hot cell. However, this periscope is not adequate to observe the fracture surface and flaw regions of PIE specimens because of the low and unity magnification.

Therefore, it is demanded to manufacture a improved functional periscope with a multi-magnification and a high resolution performance.

2. Methods and Results

In this section existing periscope is described and newly manufactured multi-magnification periscope is introduced.

2.1 Unity magnification periscope

Figure 1 shows the unity magnification periscope before the installation in the hot cell. This periscope is designed to penetrate horizontally the concrete shielding wall for the radiation protection. The stage for the movement of PIE specimens can easily move in rectangular direction and can be controlled the position in detail.



Figure 1. Unity magnification periscope

The resolution of the CCD camera is $1,392 \times 1,040$ pixel and the pixel size is $4.65 \mu\text{m} \times 4.64 \mu\text{m}$. LED ring-light is attached as a light source.

2.2 Multi-Magnification periscope

Figure 2 shows a newly manufactured multi-magnification periscope. Upper left part cylinder is the CCD camera which is enclosed by lead materials to protect the camera from the radiation.

All the operation of this periscope is controlled through the computer software. Then Image-Pro Plus 5.1 software program is used to capture an image and to analyze that image.

The multi-magnification periscope cover a range of 10X magnification ~ 60X magnification. The working distance is fixed with 170 mm. And the field diameter extends over 11.20mm ~ 3.56mm.



Figure 2. Multi-magnification periscope

2.3 Macroscopic Images using the multi-magnification periscope

Figure 3 and Figure 4 show macroscopic images in 10X magnification and 60X magnification respectively. The specimen in these images is made of un-irradiated nuclear fuel pellet.

It was confirmed that the macroscopic image of 10X magnification has a good resolution and excellent sharpness enough to observe pores and cracks clearly. Also in the macroscopic image of 60X magnification pores and cracks are more clearly observed.

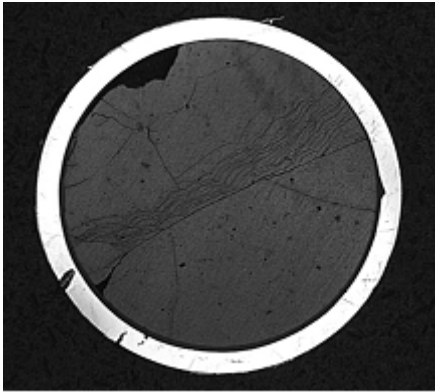


Figure 3. Macroscopic image of 10X

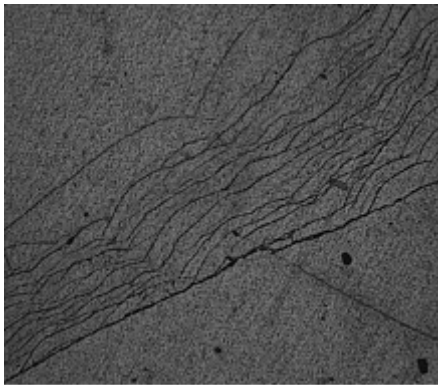


Figure 4. Macroscopic image of 60X

3. Conclusion

Newly manufactured multi magnification periscope has a good resolution and excellent sharpness. So it is expected to improve the macroscopic image analysis technique of PIE specimens. And also it will be applied to measure more accurately the size of certain PIE specimen which is in difficulty to be mounted because of the complex shape or large size.

REFERENCES