Development of Laser Marking System in Hot Cell

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1. Introduction

The IMEF is the infra facility to perform the post irradiation examination(PIE) for the nuclear fuels and the structural materials irradiated in HANARO and operated in the NPP's as shown in Fig. 1. The main goal of the facility is to support the PIE data and also the inventory report should be kept for the testing and stored materials in a hot cell.

In the present study, a marking system was designed to establish a sample identification and tracking procedure of irradiated materials which are stored and fabricated in a hot cell. The feasibility of the laser marking system was demonstrated using various types of unirradiated tube specimens as shown in Fig. 2.

Fig. 1. Hot Cells of IMEF at KAERI

Fig. 2. Unirradiated tube specimens for the laser marking tests

2. Methods and Results

Testing and remnant materials should be stored for certain period and in the absence of any other arrangements, the materials should be sent to disposal. Sample tracking and labeling should be established to keep the material inventory report based on the policy of the facility. Most samples from HANARO and surveillance capsules have identification numbers on the outer surface. However specimens fabricated in a hot cell do not have any identification number on it.

The fabrication technique of the irradiated structural materials are recently under development to support the following projects: the dry storage of the spent fuel, Wolsong unit 2 PTS, decommissioning the Kori NPP unit 1 and reconstitution of testing specimens from HANARO.

Once the specimens have been fabricated, all specimens shall be subjected to measurement of all specified dimensions. Then sample identification tracking procedure should be provided for all sampling materials to keep the traceability of samples.

Fig. 3. Laser marking machine and set-up of the sample.

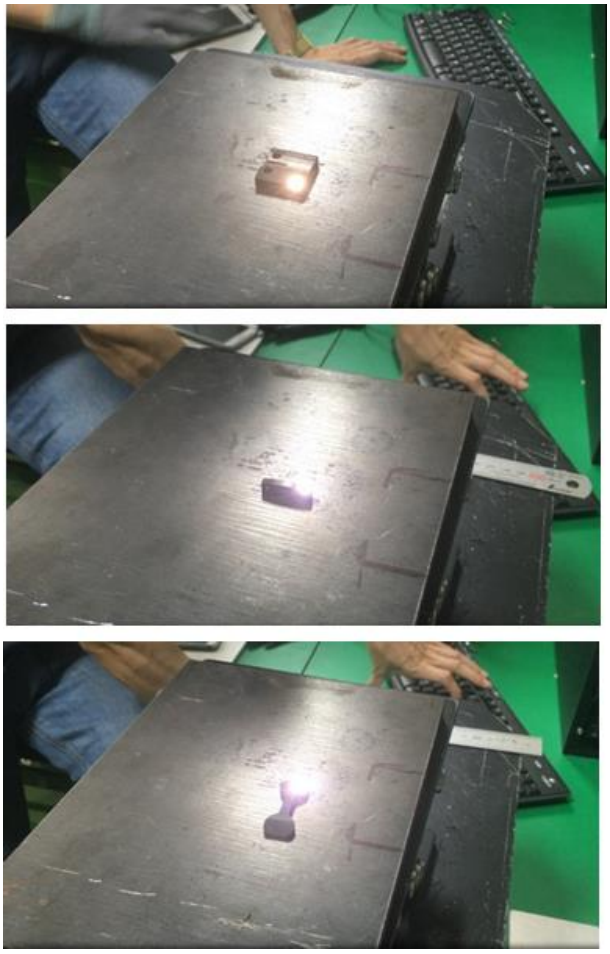

Fig. 4. Demonstration of the laser marking process with unirradiated samples.

The general ways to keep the sample tracking in a hot cell are to paint the sample or put the sample into the labeled sample holder. This procedure is mostly effective way to verify the sample identities during testing and storage in a hot cell.

It was found that the laser system using Nd:YAG with fiber optic beam delivery has great potential in material processing applications of the irradiated materials due to non-contact process [1]. The commercial laser marking machine was selected to evaluate the performance of the laser marking for the unirradiated tube specimens as shown in Fig. 3. Firstly the position and size of an identification number was decided to minimize the effect of the marked zone to mechanical properties. Various types of specimens was processed as shown in Fig. 4. The samples with identification numbers by the laser marking machine are shown in Fig. 5. It was found that the laser marking system was applicable to samples with various shapes.

Fig. 6 shows the design of the laser marking machine in a hot cell. The machine should be remotely operable system in radioactive environment. Thus the design requirements include ease in handling and changing the specimen with a manipulator in a hot cell.

Fig. 5. Various types of specimens with identification numbers after laser marking.

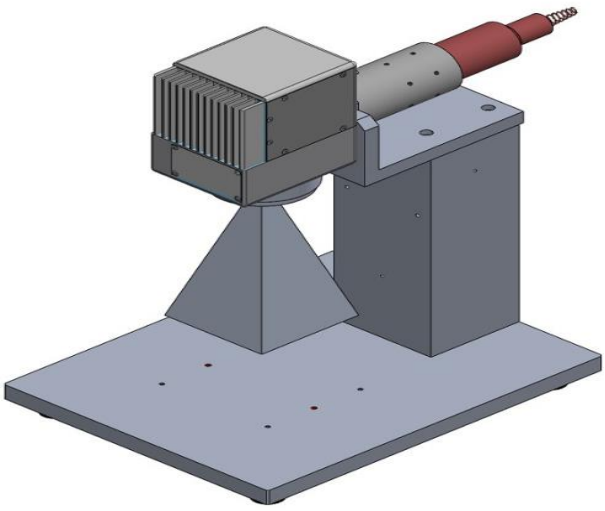

Fig. 6 Concept design of the laser marking machine.

3. Conclusions

Laser marking system was introduced to verify the identities of irradiated materials in a hot cell. Various types of unirradiated samples were successfully tested and this technique will be modified and developed for the tracking of various types of irradiated specimens in the hot cell.

REFERENCES

[1] E. Kannatey-Asibu, Principles of Laser Materials Processing, Wiley, New Jersey, 2009.