

# Sample Preparation Techniques for Post Irradiation Examinations in the Reactor Fuel Examination Facility

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## Introduction

Reactor Fuel Examination Facility (RFEF) is one of the largest hot laboratories in Japan. In RFEF, several kinds of PIEs are performed to evaluate the safety and reliability of spent nuclear fuels, and the data from PIEs is provided to the customers such as nuclear researchers and fuel vendors. In these years, the requirements from our customers become more complicated and more accurate, so that the sample preparations such as cutting, holding or defueling prior to PIE itself must be improved to meet their requirements. In this report, several sample preparation techniques for PIEs are described.

## Sample preparation techniques for PIEs

**Cutting of various shaped samples.** Most of the sample preparation devices installed in RFEF's hot cells are designed to apply a rod- or a pellet-shaped samples which has cylindrical forms. On the other hand, one of the PIE requests was to perform the composition analysis for the TMI-2 debris which has a non-cylindrical shape formed from the molten reactor core elements during the accident. To cut the TMI-2 debris for the SEM observations, the previous type of sample holder is not applicable because of its complicated shape. Therefore, the improved chucking device was necessary to hold the non-cylindrical shaped sample for its cutting. Figure P24 shows the improved chucking device for TMI-2 debris which has the multiple clamp bolts to hold the debris sample by several different angles. The device can hold the non-cylindrical shaped samples completely, and samples can be cut at the aimed cutting line precisely.

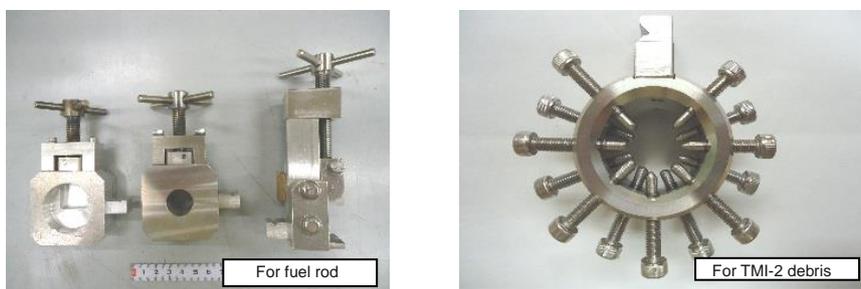
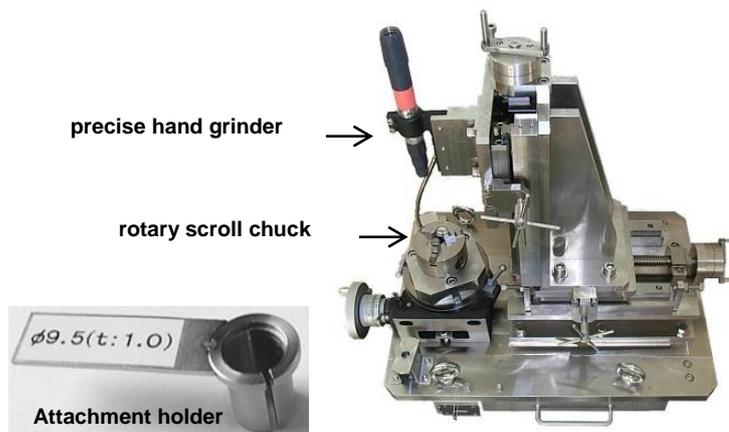


Figure P24: Normal sample holder and improved chucking device

**Defueling device for hydrogen analysis of cladding tube.** It is very important for the precise hydrogen analysis of cladding tube to prevent the influence of the hydrogen from the fuel pellets. Therefore, the defueling from the cladding is one of the most important procedures for the sample preparation of the hydrogen analysis to ensure its precision. Figure 2 shows the appearance of the defueling device developed in RFEF. This device mainly consists of the precise hand grinder, rotary scroll chuck and XYZ stage. The fuel cladding sliced with the fuel pellet as approx. 1 mm thickness

is set on the rotary scroll chuck with its dedicated attachment holder and the pellet is grinded with hand grinder to the utmost. Attachment holder protects cladding tube from scratches and makes handling of 1 mm thick samples easy. With this defueling device, the influence of the fuel pellet on the precision of hydrogen analysis can be reduced as possible, and at the same time this device is also effective to save the gamma-ray exposure of the operators and to reduce the contamination of the glove box in which the hydrogen measurement apparatus is installed.

Figure P25: De-fueling device and attachment holder



**Sample holder for minimum sample piece.** As the PIE requests become more precise, the sample size gets smaller and smaller. RFEF is the hot laboratory designed to perform PIEs with scale ranging from the fuel assemblies to the fuel pellets/claddings, so that the manipulator claws are not fit to handle the millimetre scale samples. Regarding one of the PIE requests, < 1mm thick sample should be inserted into the 1 mm gap slit to observe the fracture surface by SEM. To perform this preparation easily, the dedicated sample holder was designed as shown in Figure P26. Sample is placed on the top side of the holder horizontally and moved to the holding slit along the inclination using the manipulator. By this procedure, the sample is set in the slit vertically and kept the position by carbon tapes.

Figure P26: Sample holder

