Comparison of the Pre-treatment Methods for the Swipe Samples

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1. Introduction

Swipe samples are used to identify undeclared nuclear activities in the suspected facilities under the provisions of the Treaty on the Non-Proliferation of Nuclear Weapons [1-4]. The present research is to establish the screening technology of swipe samples prior to the mass spectroscopic determination. The sample pre-treatment of the swipes is necessary for performing the fission track analysis. We have developed the pre-treatment techniques suitable for the swipe samples from KAERI facilities. It was also discussed here that the handling techniques of micro-particles in the swipes were developed using various micro-tools.

2. Methods and Results

2.1 Swipe samples

The cotton clothes (Texwipe-304 cotton cloth) used to smear swipes were divided in four for the pretreatment of the swipes prior to the fission track analysis. There are three different methods for the pre-treatment of swipes; direct, ashing, and extract method. For the direct method, swipe was directly contacted with a Lexan track detector without any pre-treatment. For the ashing method, the swipe was placed in quartz crucible and heated to 800℃ in a muffle furnace. The ashing residue was then solidified using the solidifying reagent (flexible Collodion : EtOH : ether = 15 : 2.5 : 6). The solid ash was then transferred into acetone to dissolve the solidified organics out. For the extraction method, an ultrasonic bath was used for retrieving the particles on swipe.

2.2 Fission Track Analysis

The particles detected from the swipes were dispersed onto a polycarbonate plate with a dilute Collodion solution and dried in air. The prepared samples were irradiated in the thermal flux of 2.7×10^{13} cm^{-1} sec^{-1} for 1 minute in the HANARO research nuclear reactor. After irradiation, the Collodion film was removed and the detector sheets were etched in a 6.25M NaOH solution for 10 minutes at 60℃ in a shaking water bath. Optical and stereo microscopes were used for the inspection of the particle according to the etched Lexan detectors. The area (1 x 1 mm^2) around the interesting particle was cut with micro-needle and knife under stereo microscope, and then transferred to Re-filament for TIMS, as shown in figure 1.

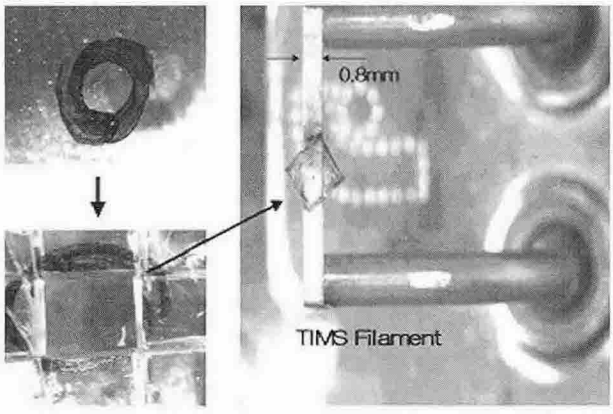

Figure 1. Marked area of fissionable particle, transferred to Re-filament for the mass spectroscopic analysis.

3. Conclusion

The direct method provided more sun-burst type fission tracks compared to the ashing method as shown in Figure 2. However, it gave the informal track shape and difficult to find the individual particles, as shown in figure 3. With the extract method very little fissionable particles were found from the swipe compare to the ashing method.

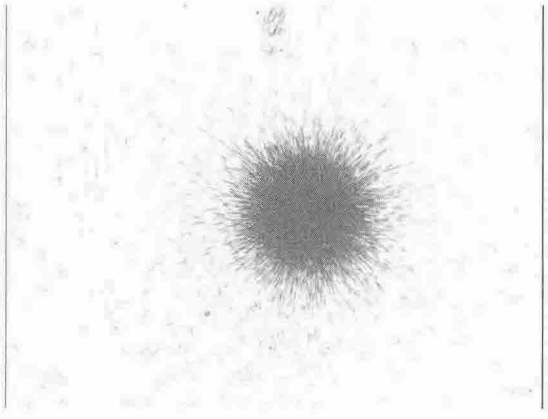

Figure 2. Photo of a typical sun-burst type fission track.

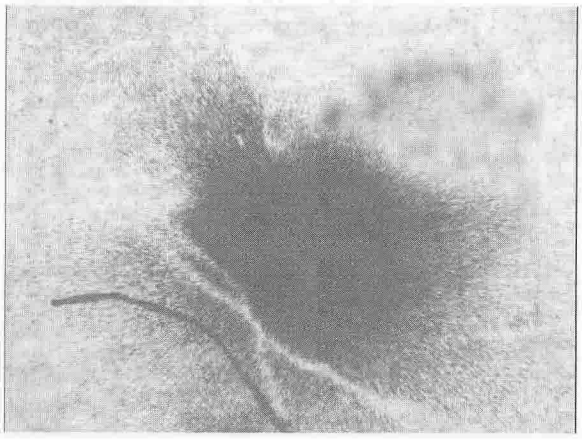

Figure 3. Photo of an informal fission track.

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