

Smear Air filter

**Detection of Fissile Materials in Smear or Air Filter Samples by
Fission Track Registration Technique**

150

smear air filter

Lexan

fission track registration

(total neutron irradiation dose) $300 \times 10^{13} \text{ n/cm}^2$ 6.25 M-NaOH 10 min.

200

가

Abstract

The fission track registration technique was investigated for the detection of fissile materials in smeared and air filter samples. The filters taken directly from the nuclear facilities were applied onto the surface of Lexan plate for neutron irradiation in the HANARO research reactor. The fission tracks in the Lexan plate were observed under optical microscope. The optimal conditions for the neutron irradiation and chemical etching were established, where the total neutron irradiation dose was $300 \times 10^{13} \text{ n/cm}^2$ and the chemical etching was done in 6.25 M-NaOH solution for 10 min., respectively.

1.

smear air filter

(²³⁵U, ²³⁹Pu)

(fissile material)

(fission track registration technique: FTRT),

가

[1]

[2]

[3],

[4]

[5]

가

가

FTRT

detector

2가

detector 2 geometry

detector

emitter,

가

, ²³⁷Np ²⁴¹Am

alpha

가

NaOH

[6]

smear filter,

air filter

Lexan plate

2.

2.1

Lexan plate(bis-phenyl acetone carbonate: GE model 8010 polished film, : 0.18 and 0.5 mm) , smear filter paper(: 42.5mm, Whatman filter paper No. 42) air filter(air sampler model : MAFF No. 6, : 100 L/ min. 8) . NaOH(Aldrich, 97%) CH₃COOH (Merck EP, 99-100%) .

2.2

Optical Microscope(LEICA DMLP, MZ6 with Digital image analysis system) Thermostatic water bath ,

2.3

air filter smear Whatman No. 42 filter paper, Lexan plate
Smear glove box
가 . Smear
(50×50cm) , filter paper
100cm² smear
0.75mg/cm² plastic foil .
(1×10¹³ n/ s · cm²) 5
Lexan plate
60 6.25 M - NaOH 10
plate 3 4 200mL ,
가 ultrasonic bath 10
Lexan plate
6×6 cm Lexan plate

3.

3.1 Filter paper

Smear filter paper
, air filter, whatman filter paper Lexan
, air filter smear
3 rabbit (NAA)

Table 1 air filter, Lexan plate smear NAA
air sampler
NAA

air filter Whatman No. 42, 가 smear
smear
Fe, Al, Ca, Cr, K, Mg, Na
Lexan plate

3.2

Lexan plate
rabbit
(1×10^{13} n/s · cm²) 5
1mR/h 가 10
 10^{16} n/cm² Lexan plate
plate
가 plate
 10^{13} n/cm² · sec
5

3.4

Lexan plate

1 μm

(NaOH)

Lexan plate

Table 2

60 1 가

Lexan plate 10 20

Lexan plate 가

3.5

Fig. 1 가 20 μm sun-burst

(: 50, 200, 400) Lexan plate

50 400

Fig. 2 Lexan plate

sun-burst blank filter

4.

smear air filter

(), (1×10^{13} n/cm² ·

sec, 5min) (6.25 M – NaOH, 10min)

Lexan

image smear air filter

Lexan plate (thermal ionization

mass spectrometer)

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Table 1. NAA results of Smear, Air filter, and Lexan plate

Element	Smear filter	Blank Filter	Air Filter	Blank filter	Lexan plate
Al	6.46E-03	6.05E-05	1.15E-01	7.88E-02	3.60E-05
As	1.12E-05	5.06E-07	2.08E-05	-	
Ba	6.43E-04	-	2.67E-02	2.20E-02	
Ca	1.42E-02	-	3.22E-02	2.28E-02	
Cl	1.58E-02	6.08E-04	3.51E-02	2.21E-02	1.40E-04
Co	2.19E-05	1.03E-07	2.10E-06	3.05E-07	1.32E-07
Cr	1.07E-03	9.06E-06	2.28E-05	1.18E-05	1.23E-06
Cs	1.68E-06	-	2.29E-06	-	
Fe	3.48E-02	3.68E-05	2.33E-03	1.97E-07	
K	6.21E-03	2.41E-05	3.09E-02	2.46E-02	
La	1.42E-05	1.14E-07	7.90E-06	4.48E-06	
Mg	5.59E-03	-	1.25E-02	-	
Mn	2.69E-04	1.44E-06	2.67E-04	7.76E-05	8.61E-07
Mo	1.04E-04	8.06E-07	-	-	
Na	4.23E-03	1.29E-04	5.70E-02	4.72E-02	1.53E-05
Sm	1.37E-06	1.03E-08	9.96E-07	8.85E-07	3.03E-08
Th	4.28E-06	-	1.80E-06	1.09E-06	
U	1.05E-05	<1.2E-10	<1.2E-10	<1.2E-10	<1.2E-10
V	1.23E-05	-	-	-	9.97E-08
Zn	1.16E-05	4.75E-06	1.54E-02	1.24E-04	3.95E-06

unit: mg / cm²

Table 2. Summary of etching conditions depend on the difference of detector^{a)}

Detector	Composition	Etching Condition	Remark
Marcrofol- N	(C ₁₆ H ₁₄ O ₃)	6N- NaOH, 50 35% - KOH, 60	Bayer Chemical Ltd.
CR- 39	Poly- Diethylene glycol bis- ally carbonate	6N- NaOH, 70	Pershore- Moulding Ltd (UK)
Lexan	Poly- Bis- phenol- acetone carbonate, (C ₆ H ₁₄ O ₃)	6.25N- NaOH, 70	GE- plastics
Hostaphan	Polyethylene - teraphthalate	33% 6N- NaOH + 33% H ₂ O + 33% CH ₃ OH, 40	
CTA	Cellulose triacetate (C ₁₂ H ₁₆ O ₈)		Kodack film
LR- 115	Cellulose nitrate	2.5N- NaOH 50 , 3h	Kodack- Pathe (France)
CN- 85	Cellulose nitrate (C ₆ H ₈ O ₉ N ₂)	2.5N- NaOH 60 , 20- 30 min.	Kodack- Pathe(France)
SR- 85	Poly- Diethylene glycol bis- ally sulphonate	6.6N- NaOH 70	Higher sensitive than CR- 39
Muscovite Mica		48% - HF 20 , 30 min.	1x10 ¹⁷ n/ cm ² High background
Soda lime glass		48% - HF 20 , 30 min.	“
Phosphate glass		10N- NaOH 50	“

^{a)} Reference ; 7 9.

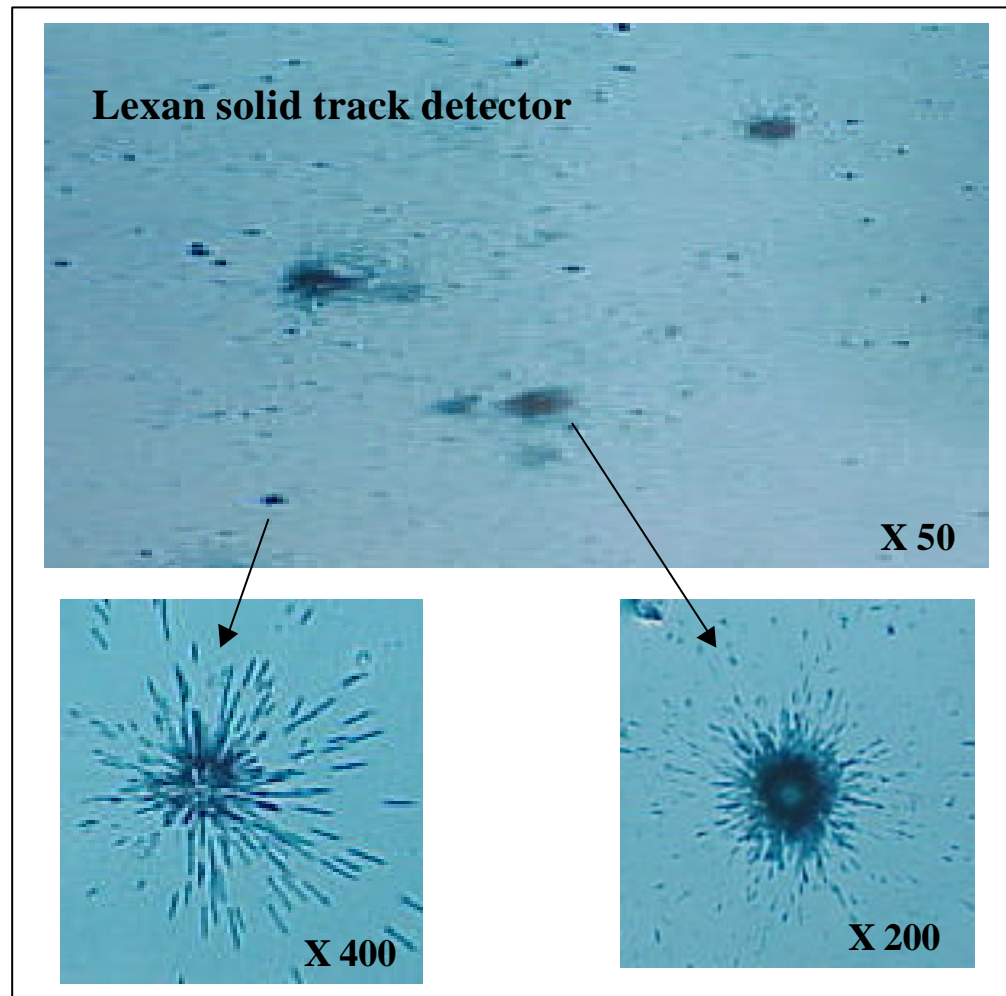


Fig. 1 The shapes of sun-burst type fission tracks observed under different magnification in a transmitted mode

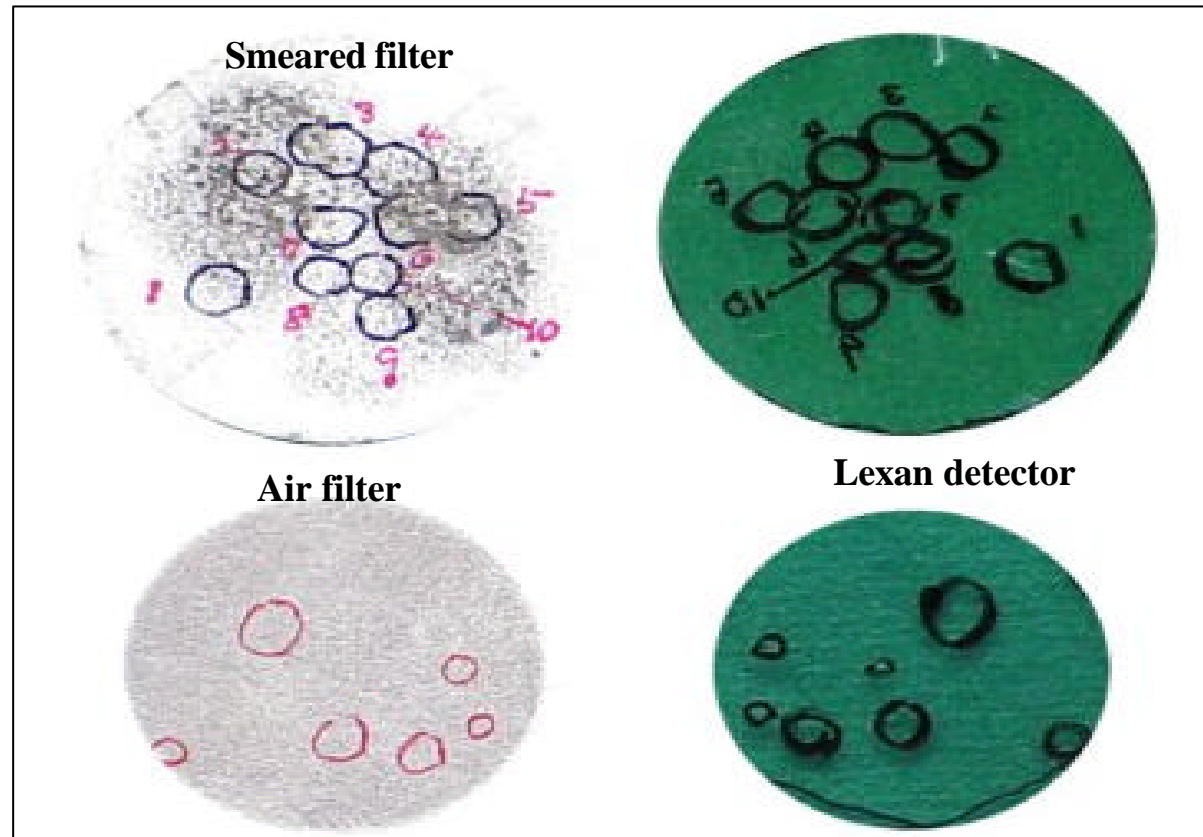


Fig.2
detector

Lexan