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ELECTROCHEMICAL ETCHING OF FISSION FRAGMENT TRACKS IN CELLULOSE TRIACETATE

RAVI CHAND SINGH and H.S. VIRK

SSNTD Laboratory, Department of Physics,
Guru Nanak Dev University,
Amritsar-143 005, India.

Abstract - Fission fragment tracks of ^{252}Cf fission fragments in cellulose triacetate(CTA) have been subjected to ECE. The detector response has been studied by changing various parameters such as the electric field strength, the frequency of applied alternating voltage and concentration of the etchant.

1. INTRODUCTION

The possibility of amplifying the tracks of various nuclear particles into large size discharge spots by the use of electrochemical etching(ECE) technique[1] has proved more advantageous than the use of conventional chemical etching. Substantial amount of work has been reported using various dielectric materials, such as CR-39, Lexan, Makrofol, PET, CN, Mica and Soda Glass. However, data available regarding ECE of CTA is scanty[2].

In the present paper, we report the ECE of fission fragment tracks in CTA at optimum electrical and etchant parameters to provide information which might help in better understanding of ECE phenomenon.

2. EXPERIMENTAL PROCEDURE

Cellulose triacetate of thickness 115 μm was obtained after removing emulsion of commercially available OR WO NP 22 photographic film. The circular samples of this plastic film of 12 mm diameter were irradiated with fission fragments of ^{252}Cf for 2 min in each case in 2π geometry. These samples were electrochemically etched with NaOH using an ECE cell as described elsewhere[3,4].

The normality of NaOH was varied from 6 to 15N at 25°C applying an alternating voltage ranging from 230 to 500 V at frequencies 0.025 to 5kHz for time intervals varying from 4 to 5 h. The tracks were counted and their diameters were measured using Carl Zeiss binocular microscope.

3. RESULTS AND DISCUSSION

To achieve the optimum ECE conditions, the interdependent variables such as voltage gradient, frequency, etchant concentration, temperature and etching time need to be optimised. Most of the researchers[5,6] suggest that first of all voltage should be optimised. But we prefered to start our experiment by varying frequency as it was found convenient in the present case.

Curves A and B (fig.1) represent the variation of track density as well as diameter in CTA as a function of a.c. field frequency. Both the curves show a distinct peak around 75Hz. It is evident from fig.1 that ECE is highly frequency dependent as no tracks were observed in the frequency range 0.15 - 5kHz.

Fig.2 shows another set of curves (a,b,c) which represent track density, background and track diameter obtained by varying applied voltage from 230 to 500 V at resonance frequency of 75Hz. It is evident from the figure that best signal to noise ratio and track size is obtained at 300 V.

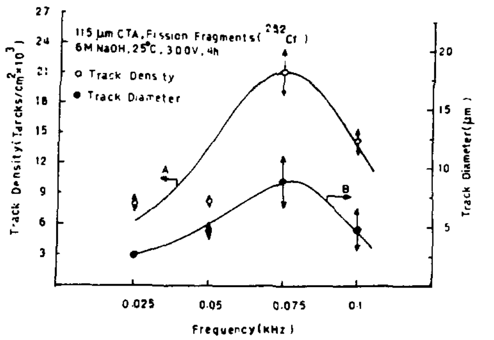

Fig.1 Track density(left) and mean diameter as the functions of frequency.

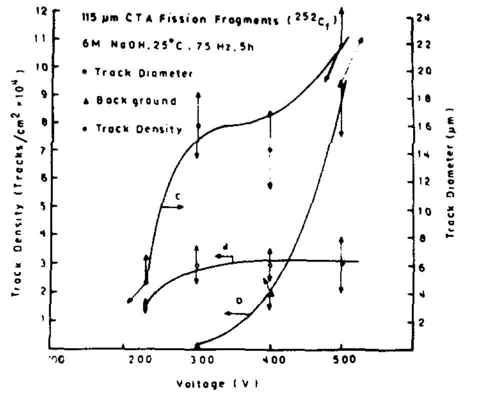

Fig.2 Fission fragment and background track densities (left) and mean diameter as functions of voltage.

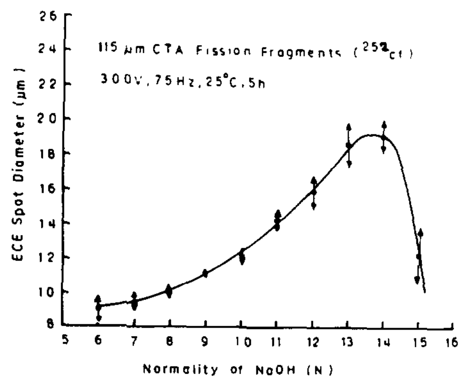

Fig.3 Mean track-diameter as a function of etchant normality.

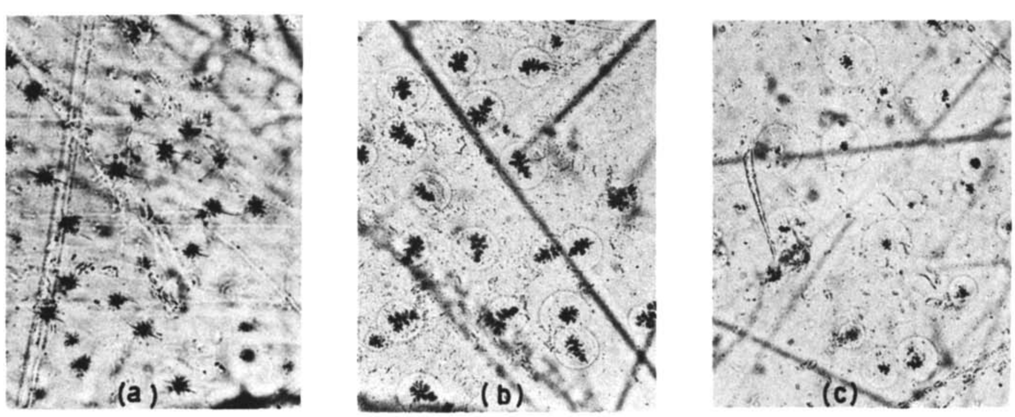

Fig.4 Photomicrographs of ECE tracks developed in 5 hr at 75 Hz, 300 V and 25°C using (a) 6N (b) 14N (c) 15N NaOH solution.

The third parameter to be optimised was the concentration of NaOH solution. Fig.3 represents variation of track diameter as a function of NaOH normality at optimum a.c. voltage and frequency. It is clear from the figure that track size gradually increases from 6 to 14N, but at higher concentrations, reduction in track size sets in.

Figs.4(a), (b) and (c) show photomicrographs of electrochemically etched fission fragment tracks when ECE was carried out for 5 h at 25°C under an a.c. voltage of 300 V at resonance frequency 75Hz using 6, 14 and 15N NaOH solutions respectively. It is evident from the photomicrographs that size and shape is well defined for normality values 6 and 14N, whereas reduction sets in at 15N. At higher concentrations, the branching of trees is less which might be due to the fact that the etchant spoiled the tree growth sites.

From the above discussion we conclude that ECE of fission fragments in OR WO NP 22 (CTA) film can be successfully carried out. The optimum parameters being a frequency of 75Hz, a voltage of 300 V (26 kV/cm) and a concentration of NaOH solution of 14N at 25°C for 5 h. The ECE of CTA is strongly frequency dependent and did not produce tracks with the method described by Gammage and Chowdhury[2] for fast neutron tracks in Kodak CTA. As the resonance peak is around 75Hz, so it is possible to etch CTA electrochemically using a simple step up transformer where power supply is 60Hz a.c.

REFERENCES

1. L. Tommasino, CNEN Report RT/PROT 1(1970).
2. R.B. Gammage and A. Chowdhury, Nucl. Tracks 4, 41(1981).
3. Ravi Chand Singh and H.S. Virk, Nucl. Instr. and Meth. B29, 579(1987).
4. Ravi Chand Singh and H.S. Virk, Nucl. Instr. and Meth. in press(1988).
5. M. Sohrabi, Nucl. Tracks 4, 131(1981).
6. G. Somogyi, Radiation Effects 34, 51(1977).