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CHARACTERIZATION OF OVERHEAD PROJECTOR TRANSPARENCY AS HEAVY ION DETECTOR

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ABSTRACT

In an attempt to characterize overhead projector transparency (OPT) as a detector material we have carried out its elemental analysis. It has been found to be a triacetate. The optimum etching conditions were found out and the bulk etch rate V_G and its activation energy E_a have been determined. The maximum etchable track lengths of ^{252}Cf fission fragments and ^{132}Xe ranges at 14.5 and 5.9 MeV/u in OPT have been measured. Further work on correlation of V_T and dE/dx is in progress.

KEYWORDS

Overhead Projector Transparency, ^{252}Cf, ^{132}Xe, 14.5 MeV/u, 5.9 MeV/u, track etch rate (V_G), activation energy (E_a), heavy ions, track detectors.

INTRODUCTION

Track detectors play a very crucial role in the field of 'trackology'. With the meagre resources at our disposal - low cost and easy procurability are the deciding factors in the selection of detectors, though the uniformity, isotropic response and sensitivity are not to be overlooked. In the light of these criteria we have attempted to characterize ordinary overhead projector transparency as a nuclear track detector.The foils have been characterized with fission fragments of ^{252}Cf source as well as with 14.5 and 5.9 MeV/u ^{132}Xe ions. The experimental data are compared with the theoretical values obtained from two sources, the computer code 'RANGE'(Dwivedi,1988) and 'TRIM' (Biersack and Haggmark, 1980). The bulk etch rate (V_G) and the activation energy (E_a) were also determined.

EXPERIMENTAL

Elemental analysis of the foil was carried out and it was found to be a triacetate with an empirical formula $C_3H_4O_2$ (Density = 1.20g/ml and the thickness ≈ 100 μm). Square pieces were cut from commercially available transparent foils of OPT with a fairly background free surface.

A 20 ng ^{252}Cf source was used for irradiation which was done at an angle of 30°. Several pieces were irradiated in this way. Two stacks of OPT one consisting of 3 foils and the other of two foils were irradiated with 14.5 and 5.9 MeV/u ^{132}Xe ions respectively at UNILAC, GSI Darmstadt. The irradiations were done at an angle of 45° to the surface of the foil.The most suitable etchant for OPT was found to be 6N NaOH at 55°C. The bulk etch rate V_G was determined at five different temperatures - 35°, 45°, 55°, 65° and 75°C. Two different methods - the track diameter method and the thickness method - were used to determine the V_G along and perpendicular to the surface. The increase in track diameter and decrease in thickness was measured at hourly intervals over a period of 12 hours. The track lengths were calculated from the formula given by Dwivedi and Mukherji(1979). A

computer code 'RF' (Dwivedi, 1988) was used to obtain the track lengths of the median light and median heavy fission fragments. Theoretical ranges for 14.5MeV/u and 5.9MeV/u ^{132}Xe were obtained from the computer code RANGE (Dwivedi; 1988) and also from the code TRIM (Biersack and Haggmark; 1980).

RESULTS AND DISCUSSION

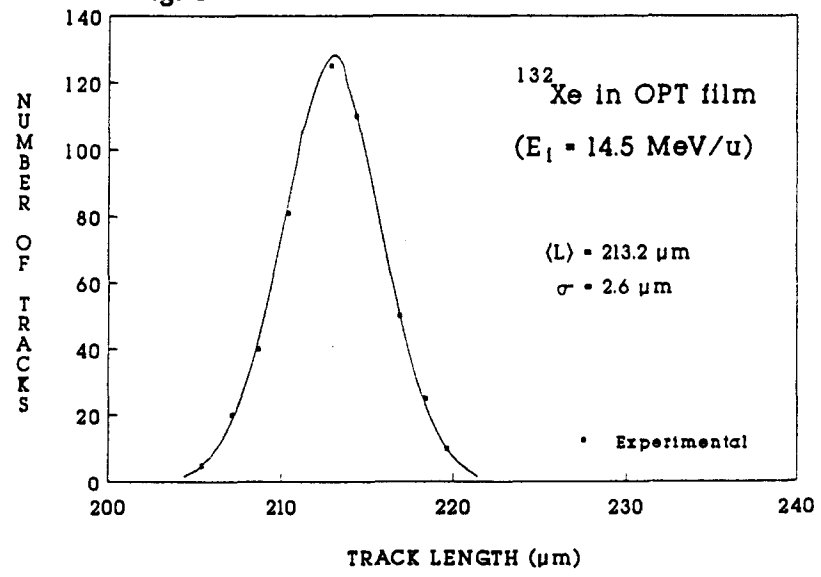
The V_G obtained by both the methods is almost identical so it is concluded that OPT is isotropic with respect to bulk etching. From the measured data the activation energy for bulk etching is found to be (59.3 ± 7.5) kJ mol^{-1}. The experimentally determined maximum etchable track length was found to be 23.3±1.9 μm whereas the theoretically computed value from 'RF',was 22.23 μm.

Tracks were observed only in the first foil of the stack irradiated by 5.9 MeV/u ^{132}Xe ions, while 14.5 MeV/u ^{132}Xe ion passed through the first foil and was stopped in the second foil. The maximum etchable track length was obtained and the track distribution curve for both the ions plotted. Figure 1 shows the track distribution at 14.5 MeV/u. Both the theoretical data 'RANGE' and'TRIM' agree fairly well (within 2-3%) with the experimental data . But at 5.9 MeV/u the 'RANGE' value is about 9% higher while the 'TRIM' value shows better agreement with the experimental data.

Table 1 Measured track lengths and calculated ranges of ^{132}Xe ions in OPT.

Energy (MeV/u)	Experimental track length (μm)	Theoretical Ranges (μm) 'RANGE'	'TRIM'
14.5	213.2 ± 2.6	219.6	222.0
5.9	84.8 ± 2.6	90.3	83.0

Fig. 1 TRACK LENGTH DISTRIBUTION



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