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HEAVY ION RANGES IN PLASTIC TRACK DETECTORS

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ABSTRACT

Plastic track detectors, viz. CR-39 and Lexan polycarbonate were irradiated at GSI, UNILAC using ^{208}Pb(13.6 MeV/u), ^{238}U(15 MeV/u), ^{132}Xe(5.6 and 14.5 MeV/u) and ^{139}La(14.6 MeV/u) beams. The experimental ranges of heavy ions are in good agreement with the theoretical ranges computed by using the computer programme based on equations of Mukherji and Nayak. Critical angle etching efficiency and REL values for plastic detectors are determined from their bulk and track etch rates. REL for Lexan polycarbonate is found to be 4.25 MeV mg^{-1} cm^{2} . The efficacy of 'Single Sheet Identification' technique for low energy cosmic ray particles is established.

KEYWORDS

Plastic track detector, heavy ions, track etch rates, ion ranges, REL.

INTRODUCTION

It has been established that polymers are most suitable material for recording heavy component of cosmic radiations (Cartwright *et al.*, 1978). Their chief merit lies in their ability to discriminate between light and heavy particles of cosmic ray flux while at the same time being insensitive to the high background of electrons, protons, neutrons and gamma radiations. The present study aims to determine the total etchable ranges of heavy ions in CR-39 and lexan and compare them with theoretical ranges. The efficacy of 'Single Sheet Identification' technique proposed by Stern and Price (1972) is also tested.

EXPERIMENTAL

Samples of CR-39 (Pershore Moulding, U.K.) and Lexan polycarbonate (General Electric, USA), 3 cm x 3 cm x 250 μm size, were cut from large sheets and irradiated at GSI, Darmstadt UNILAC facility using heavy ion beams of ^{208}Pb(13.6 MeV/u), ^{238}U(15 MeV/u), ^{132}Xe(5.6 and 14.5 MeV/u) at different incident angles. The experimental details are given elsewhere (Sidhu, 1990). It has been found that our experimentally determined ranges are in good agreement with the corresponding theoretical values (Tables 1 and 2).

The REL values are calculated for Lexan polycarbonate using the polynomial of Tripier and Debeauvais (1977). REL values are plotted as a function of V_T and REL$_{crit}$ for Lexan polycarbonate is found to be 4.25 MeV mg^{-1} cm^{2}.

'Single Sheet Identification' technique proposed by Stern and Price (1972) has been tested for CR-39 and Lexan plastic for heavy ion identification

since the etchable cone length for all the ions is less than the thickness of the single sheet of detector. Plots of cone length (L) versus residual range (RR) are shown in Figs. 1 and 2 for CR-39 and Lexan polycarbonate, respectively. Clustering of the points clearly shows that points corresponding to the same ion lie on a single curve. From the knowledge of known charges, the identity of the unknown particles can be determined.

Table 1. Experimental and theoretical computed ranges of heavy ions in CR-39.

Ion	Energy (MeV/u)	Total etchable range (μm)	Theoretically computed range (μm)
^{132}Xe	5.6	71.5	70.8
^{132}Xe	14.5	186.2	185.0
^{238}U	15.0	196.1	194.0
^{208}Pb	13.6	160.8	159.8

Table 2. Experimental and theoretical computed ranges of heavy ions in Lexan polycarbonate.

Ion	Energy (MeV/u)	Total etchable range (μm)	Theoretically computed range (μm)
^{208}Pb	13.6	186.9	186.3
^{139}La	14.6	198.6	196.2
^{238}U	15.0	212.4	209.3

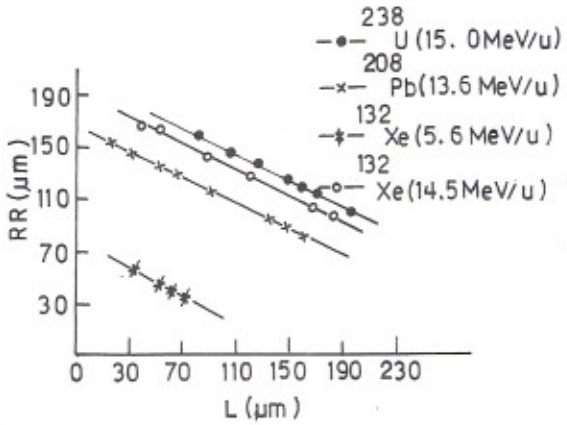

Fig.1. Plot of RR vs L for heavy ions in CR-39.

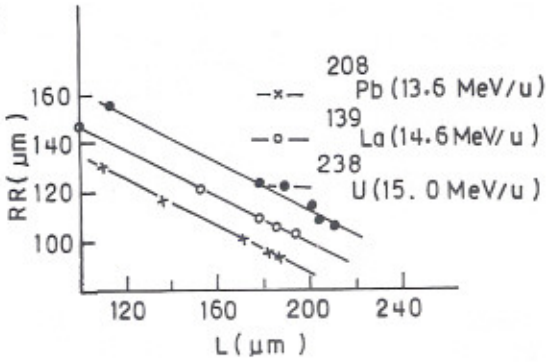

Fig. 2. Plot of RR vs L for heavy ions in Lexan.

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