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ANNEALING STUDIES IN PLASTIC TRACK DETECTORS

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In our GSI report[1] of 1987 we carried out study on annealed tracks of 18 MeV/n Nb-93 ions in CR-39 plastic track detector. The data was used to fit into the empirical relation proposed by Modgil and Virk[2] and Price et al.[3] The work has since been extended to include Pb-208(17.0 MeV/n) and La-139(14.6 MeV/n) heavy ions, irradiated in CR-39 and Pb-208 (13.6 MeV/n), La-139(14.6 MeV/n) and U-238 (16.0 MeV/n) irradiated Lexan polycarbonate. The results obtained in the calculation of E_a, activation energy of annealing for these detectors in both types of formulations gave a constant value of 0.20 eV for CR-39 and 0.17 eV for Lexan whereas n the exponent of annealing time was seen to vary with the nature and energy of the ion beam.

The analysis of the data projected some shortcomings in both these formulations[4]. The drawbacks lead us to search for a new equation which would fit experimental data and remove the constraints. It was observed that the major drawback in the application of the formulation of Modgil and Virk is that the annealed lengths do not reflect the change in track etch rate. This along with the proposed formulation of Price et al.[3] projected the possibility of introducing the track etch rate, V_t, in a more direct form than that of the earlier workers.

We have found that if the annealing rate V_a, is replaced by the instantaneous track etching velocity, the constraints are removed. Thus the earlier equation becomes,

$$\frac{d}{dt_a}(V_t) = A\, t_a^{-n} \exp(-E_a/kT) \qquad (1)$$

where V_t is the track etch rate, t_a, the time for which the samples were annealed at an annealing temperature T_a and the remaining terms have their usual meaning. The results obtained have been tabulated (Table 1).

It is observed that E_a, the activation energy of annealing for all three formulations give a constant value 0.20 eV for CR-39 and 0.17 eV for Lexan polycarbonate irrespective of the energy and type of ion beam used. Hence we conclude that E_a, is solely a detector property.

Table 1

Ion Beam	Energy (MeV/n)	n-value	Activation Energy(eV)
	CR-39		
Nb-93	18.0	0.44	0.198
La-139	14.6	1.28	0.197
Pb-208	17.0	1.60	0.195
	Lexan		
La-139	14.6	2.140	0.170
Pb-208	13.6	3.00	0.171
U -238	16.0	2.63	0.170

1. R.K. Bhatia, A.S. Sandhu and H.S. Virk (1987) GSI, Scientific Report, 241.
2. S.K. Modgil and H.S. Virk (1985) Nucl. Instr. Meth. B12, 212.
3. P.B. Price., G. Gerbier., H.S. Park and M.H. Salamon (1987) Nucl. Instr. Meth. B27, 53.
4. R.K. Bhatia and H.S. Virk (1988) Radiat. Effects and Defects in Solids Ref. No. RE 5046 (In Press).