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Etching time and temperature relationship for CR-39

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When CR-39 plastic detector was introduced as a nuclear particle detector, other solid state nuclear track detectors were already in the field for more than fifteen years. However CR-39 proved to be very efficient as a detector for low charge light particles. The remarkable discovery of G Tarle' et *al* (Tarle' et *al* 1981) that addition of about 1% dioctyl phthalate (DOP) to CR-39 monomer greatly improves its optical quality and surface smoothness even after prolonged chemical etching made CR-39 (DOP) detectors widely used in different disciplines. An extensive literature is available on the behaviour of CR-39 and CR-39 (DOP) to different parameters affecting etching. In the present work, we have attempted to find out the relationship between etching time (t) and etch temperature (T) after studying the effects of these two separately on the response of α-particles on CR-39 (DOP), manufactured by Pershore Moulding Limited, UK, and detector type MA-ND/α (sheets cast from CR-39 monomer) supplied by Atomki, Debrecen, Hungary.

First of all, we have studied the effect of etching time (t) on these detectors. For irradiating the detector foils, we have used a mixed source of α's (Am, Cm, Pu) of energy around 5.5 MeV.

The foils of both the types, after being irradiated by the above source for 6 hrs were chemically etched for 3 hours, the etchant being NaOH of 6.23 ($\pm$ 0.01) N, the other parameters of etching being same as reported earlier (De et *al* 1989). Scanning was done under a Leitz Optical Microscope fitted with a filar micrometer eyepiece of least count 0.074 μm per circular division of the micrometer screw. The average diameters were found out for both the foils from histograms. Then the samples were successively etched by one hour i.e. etched for 4, 5, 6, 7 and 8 hours. Scanning after each step yielded the average diameters. The slopes $\left(\frac{dD}{dt}\right)_{T=70°C}$ for track diameter vs etching time were calculated for each detectors.

As a next step, we studied the effect of etch temperature (T) on the detectors. After irradiation by the above source for 6 hours, we etched different foils at different temperatures for 3 hours. The average diameters were calculated after each step.

It was seen that the nature of variation is linear upto a certain temperature and then as the temperature is increased it deviates from linearity. From the linear portion of the curves, the slopes $\left(\frac{dD}{dT}\right)_t$ were calculated. Throughout this work other parameters affecting etching like concentration of the etchant were kept constant.

From these observed data $\left(\frac{dt}{dT}\right)_D$ is then determined and the results verified with fresh experiments and reported.

We are also trying to extend the work for different types of detectors a few of which are expected shortly.

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