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RADIATION DOSE MEASUREMENTS USING SOLID STATE DETECTORS

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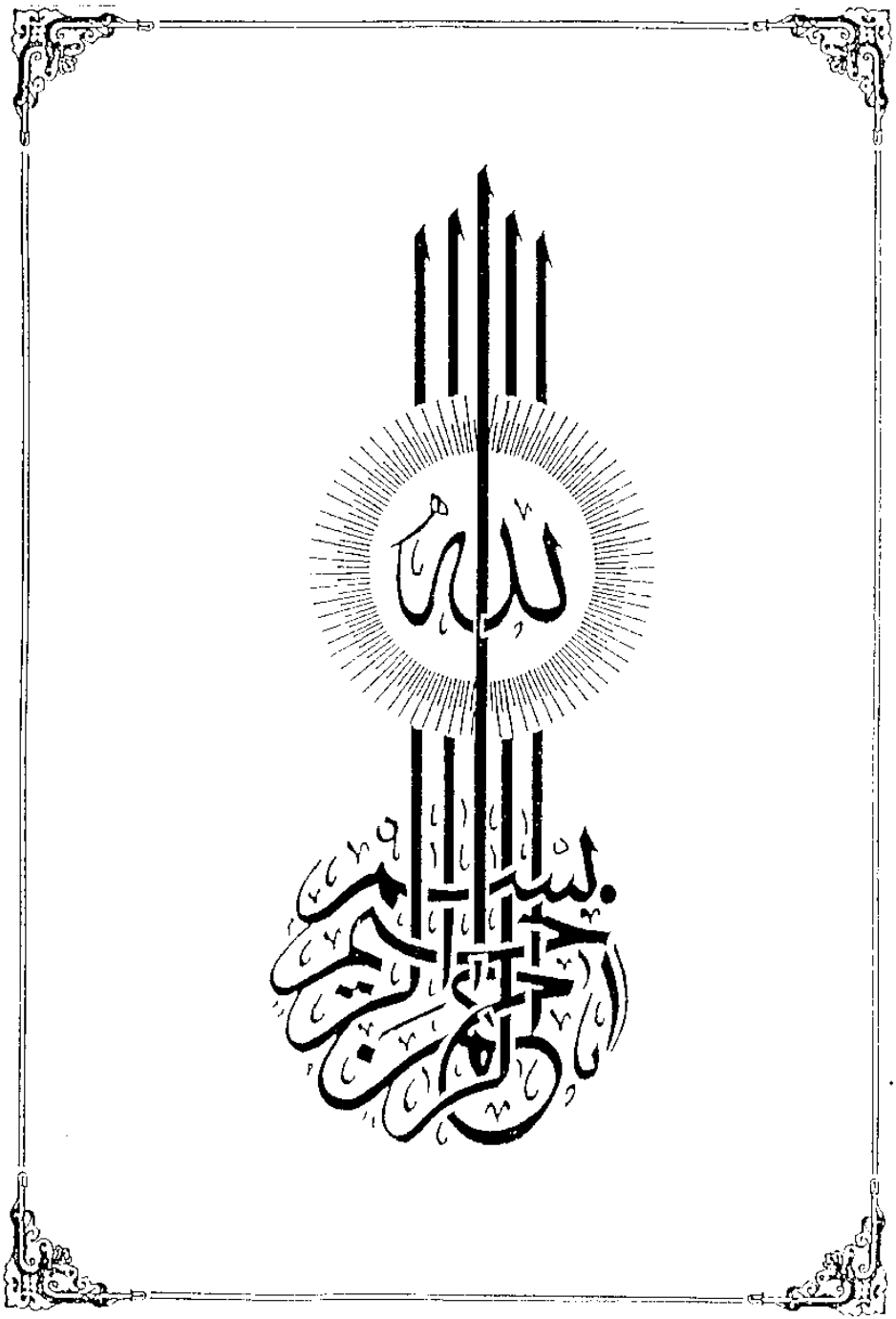

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SUMMARY

Solid State Nuclear Track Detectors especially plastic detectors are being widely nowadays in a variety of application through the field of radiation dosimetry due to their several advantages; they are small in size, flexible in geometry, can be used for discriminating against high background of less ionizing radiation, they are integrating detectors, besides excellent properties of data analysis and high registration sensitivity.., etc.

Through this work, three types from SSNTDs were used (CR-39 diglycol carbonate, LR-115 cellulose nitrate and Makrofol polycarbonate) for studying the characteristics of some alpha-sensitive solid state nuclear track detectors for dosimetric purposes covering both low and high energy alpha particles (wide range from 4.9 to 34 MeV). Also covering both low and high doses from gamma-rays, ranging from 10 Gy to 600 KGy, and for heavy ions such as ^{28}Si (670 MeV,) .

The results can be summarised as follows:..

(1) Various treatment of chemical etching were performed and optimal conditions were found for each detector. Detection efficiency values and sensitivity parameters of the studied plastic foils were determined. The dependence

of bulk etching rate (V_B) and track etching rate (V_T) on etching temperature and concentration of the used detectors were studied and found that V_B and V_T increaase with the temperature and concentration of the etchant, the activation energy of each detector is obtained and it is found to be E_B = 0.89, 0.36 and 0.26 eV and E_T = 0.77, 0.64 and 0.39 eV for CR-39, LR-115 and Makrofol respectively, also the exponent values n_B = 1.21, 0.30 and 0.50 while n_T 1,3.66 and 0.73 for the same detectors respectively.

(2) The effect of pre-and post-gamma irradiation on the etching parameters for the used detectors were studied. The results indicate that the bulk and track etching rate were increased with gamma dose (ranging from 10 Gy to 100 KGy) in both the experimental schedules (pre-and post-gamma irradiation). Also the response ratio [(V_{BT}/V_{BO}) and (V_{TD}/V_{TO})] of the three detectors increases with increasing gamma-doses in both pre-and post-irradiation techniques.

(3) The induced changes in colour and optical absorption of CR-39 and Makrofol using high intensity gamma rays have been investigated. The spectral transmission values of unirradiated and irradiated detectors (gamma dose from 50 to 600 KGy) were measured using

spectrophotometric technique. The optical energy gap, the width of the band tail, the tristimulus values and the colour difference of these detectors were calculated. It is found that Makrofol detector is more response to colour change by gamma-irradiation than CR-39 and can be used as gamma dosimeter from 200-500 KGy with limited sensitivity. Also they are not destroyed by these high doses which may be considered advantagous especially in the field of sterilization.

(4) The alpha-particles response which is characteristic of polycarbonate CR-39 has been investigated. The mean track diameter as a function of alpha energy in the range from 5.1 to 34 MeV was examined. The mean track diameter or size of the tracks are found to be energy dependent which decreases as alpha energy increases with a trend at about 14 MeV alpha energy. With regard to the spectroscopy of alpha from track radii, it was stated that the discrimination of lower alpha energies shows better results than the high energies for the present etching condition.

(5) High energy of heavy ions ^{28}Si ions of 670 MeV, registration in CR-39 detector have been investigated. Experimental results were obtained interms of frequency distribution of

the track diameter, track density and bulk etching rate. A dependence of the mean track diameter on energy was found. The bulk etching rate found to be 20.8μm/hr, the increase of bulk etching rate may be attributed to increase of the incident energy of the particles. Results incidated that it is possible to produce etchable tracks of ^{28}Si in this energy range in CR-39. We also report the etching characteristics of these tracks in CR-39 detector.