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Anomalous Effect of Temperature on Fission Fragment Tracks in Soda Glass

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IN THEIR technical note, YADAV *et al.*[1] make the following observations regarding the effect of temperature on etching of fission fragment tracks in soda glass:

(i) for a given etching time, the etch pit diameter increased with etching temperature,

(ii) the etch pit diameter increased with etching time first rapidly and then at a slower and constant rate, and

(iii) the etch pit diameter vs etching time curve for higher temperatures (say 72°C) showed a deviation from the one expected (Ref. Fig. 1).

All these observations are correct and have been verified by us experimentally.[2] However, the following explanation supplied by YADAV *et al.*,[1] in support of observation (iii), seems to be contradictory: at higher etching temperatures, etch rates are significantly increased and hence result in thicker EPLs*. Furthermore, the effect of EPL is more severe inside the etched tracks than at the surface of the sample. This increases the cone angle of etch pit and hence decreases the growth rate of etchpits.

In support of their above argument the authors supply data (Table 1, Ref. 1) and conclude, "The decreasing trend of average largest observable diameter with increase in etching temperature also supports this explanation." Authors have recorded a decrease of etch pit diameter from 48 to 14 μm when etching temperature varies from 10 ± 1° to 72 ± 1°C.

In our experiments using 12% HF and a new etchant (proposed by the authors of the note somewhere else) $HF:H_2SO_4:H_2O::9:3:27$ we have observed that average etch pit diameter increases with increase of etching temperature upto 70°C in case of 12% HF (Table 1). In the second case, the diameter increases with etching temperature up to 75°C but its value decreases at 100°C (Table 2). It clearly establishes that their observation (iii) is attributable to annealing of tracks during etching at high temperatures and the explanation given by the authors in their note is self-contradictory.

In conclusion it may be stated that it is a well established fact that etching and annealing are both diffusion processes and hence temperature dependent. It is observed that increase of temperature accelerates both the etching and annealing rates. The two effects work in opposition to each other. It is therefore advisable to etch the fission fragment tracks in glass at low temperatures using prolonged etching times.

* Etch Product Layers.

TABLE 1. Average largest observable diameter of Cf^{252} fission fragment etch pits in soda glass

Etching time 1 min, 12% HF

Temperature (°C)	−5	15	29	50	70
Etch pit diameter (μm)	1.45	2.29	5.41	11.91	18.80

TABLE 2. Etching time 5 min

$HF:H_2SO_4:H_2O::9:3:27$

Temperature (°C)	0	27	50	75	100
Etch pit diameter (μm)	3.2	5.3	10.6	15.7	9.2

References

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2. MODGIL S. K. and VIRK H. S. *Curr. Sci.* (submitted).