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Title: STRENGTH MEASUREMENTS OF CRYSTALLINE AND FUSED QUARTZ WAFERS

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STRENGTH MEASUREMENTS OF CRYSTALLINE AND FUSED QUARTZ WAFERS

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Recently, during the fabrication of SIS junctions at the University of Virginia, it was found that the quartz appeared to be much more brittle than usual, resulting in most of the wafers breaking during processing.

In order to understand why the quartz was breaking, an experiment was set up to measure the amount of torque required to break samples of quartz from different wafers. The following is a list of the seven wafers tested:

<u>WAFER</u>	<u>ORIENTATION</u>	<u>TYPE</u>	<u>AV. BR. TORQUE</u>	<u>MANUFACTURER</u>
INV 207 (NRAO)	Fused	4012	3514	Amersil
INV 254 (NRAO)	Z-Axis x-y unknown	Xtal	2562	Specialty Engr.
TRI-88A5 (UVA)**	Z-Axis x-y unknown	Xtal	3677	Specialty Engr.
TRI-1181 (UVA)*	Z-Axis x-y unknown	Xtal	4223	Specialty Engr.
TRI-93B1-4T2 (UVA)*	Z-Axis x-y unknown	Xtal	1894	Specialty Engr.
TRI-93B1-4T4 (UVA)*	Z-Axis x-y unknown	Xtal	2501	Specialty Engr.
TRI-111A1 (UVA)*	Z-Axis x-y unknown	Xtal	2860	Specialty Engr.

All material was 0.010" thick. The wafers marked * had seemed unusually brittle and had broken during SIS fabrication. The wafer marked ** seemed to have normal strength, and had been processed with no difficulty.

A number of samples, 0.100" long x 0.010" wide, were cut in each of three orientations (0°, 45°, and 90°) from each wafer (Figure 1). In each test, five samples with the same orientation were mounted on the end of a microscope slide using Miller-Stephenson 907 epoxy. The samples were mounted with 0.075" protruding beyond the end of the slide (Figure 2).

To measure the torque required to break the samples, an Ohaus 0-250 gram spring gauge was used in the setup shown in Figure 3.

The results for each wafer are shown in Figures 4-10, and the average breaking torques are given in the table above. There appears to be no clear correlation between the breaking strength measured in these tests and the tendency for the wafers to break during SIS processing. In fact, the strongest wafer measured was one of those that had broken easily in processing.

The delicate wafers all had unpolished edges. Although the top and bottom surfaces of each wafer were polished, the edges were rough and chipped. It is conceivable that breaking was caused by stress concentrations or small cracks at the rough edges. Future quartz wafers should therefore be ordered with polished edges.

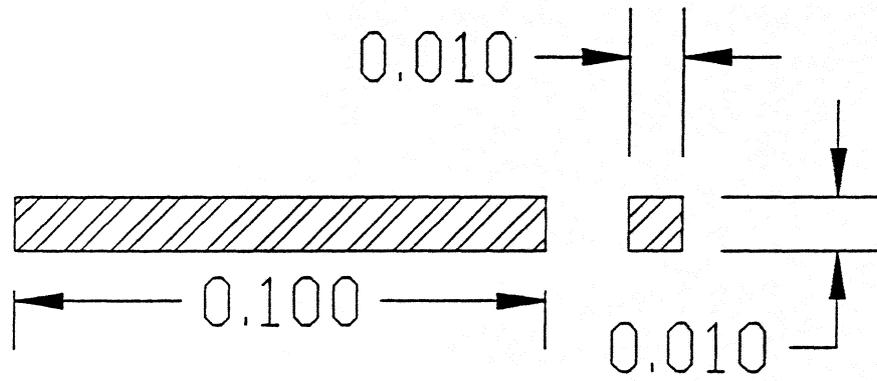


Figure 1

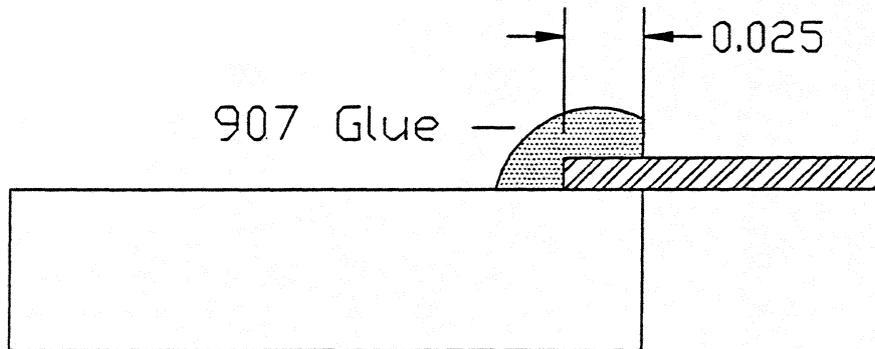


Figure 2

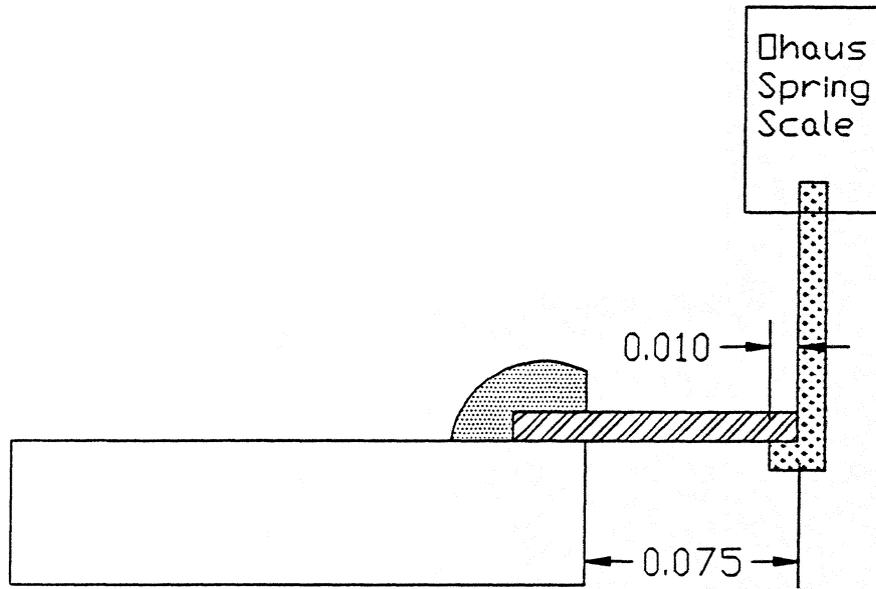


Figure 3

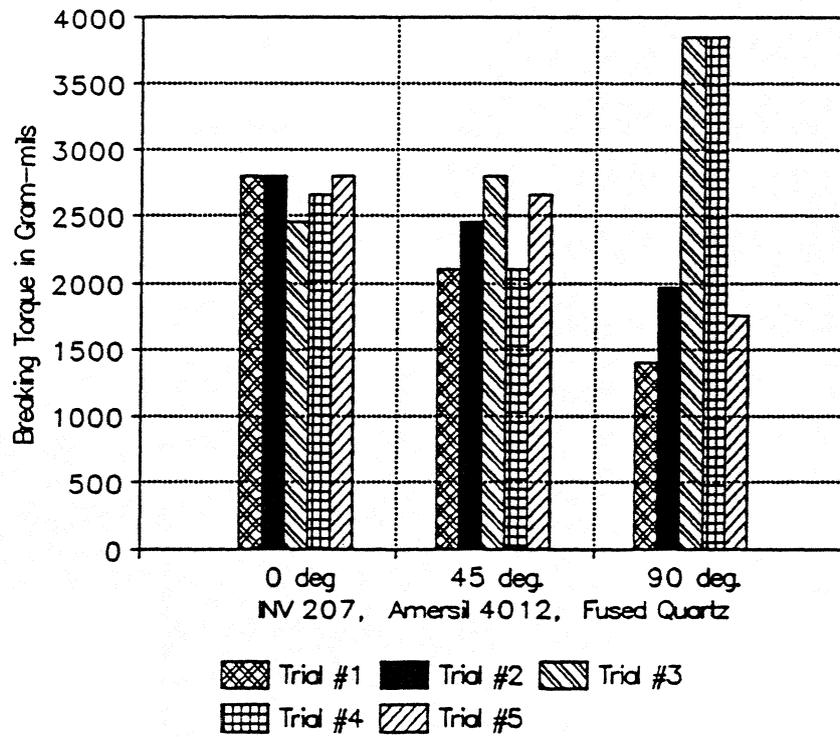


Figure 4

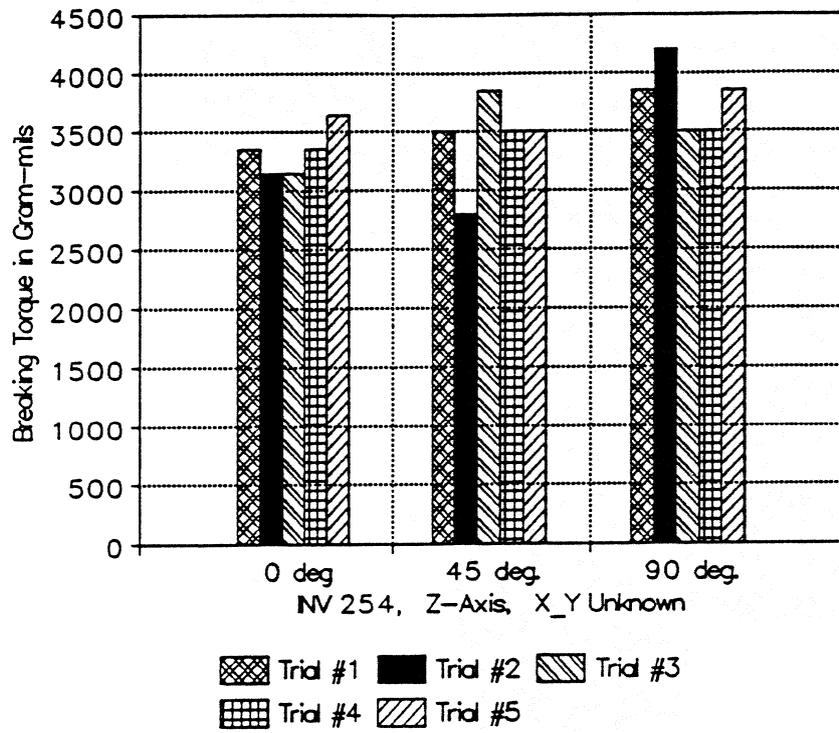


Figure 5

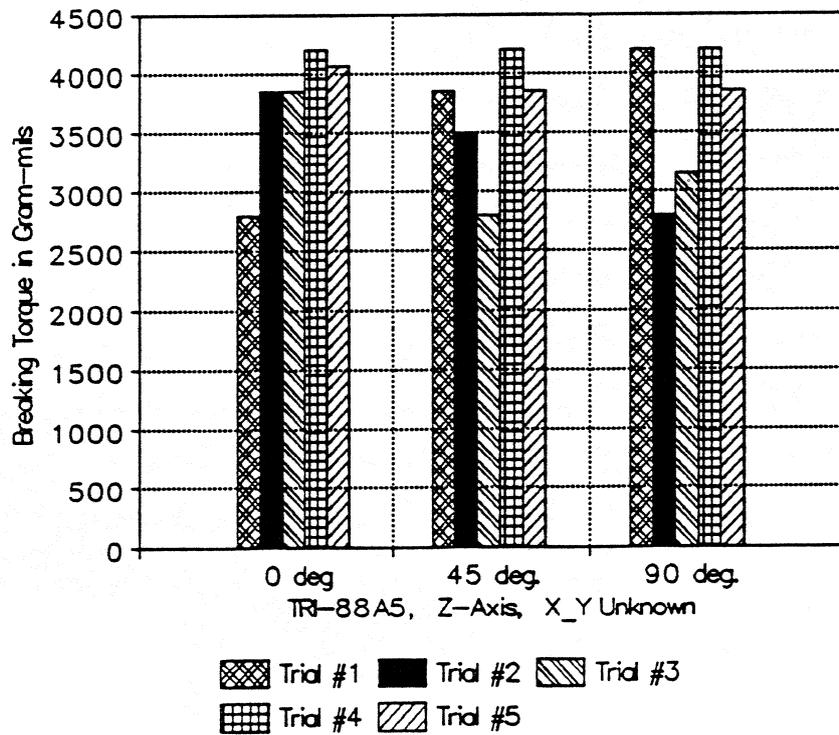


Figure 6

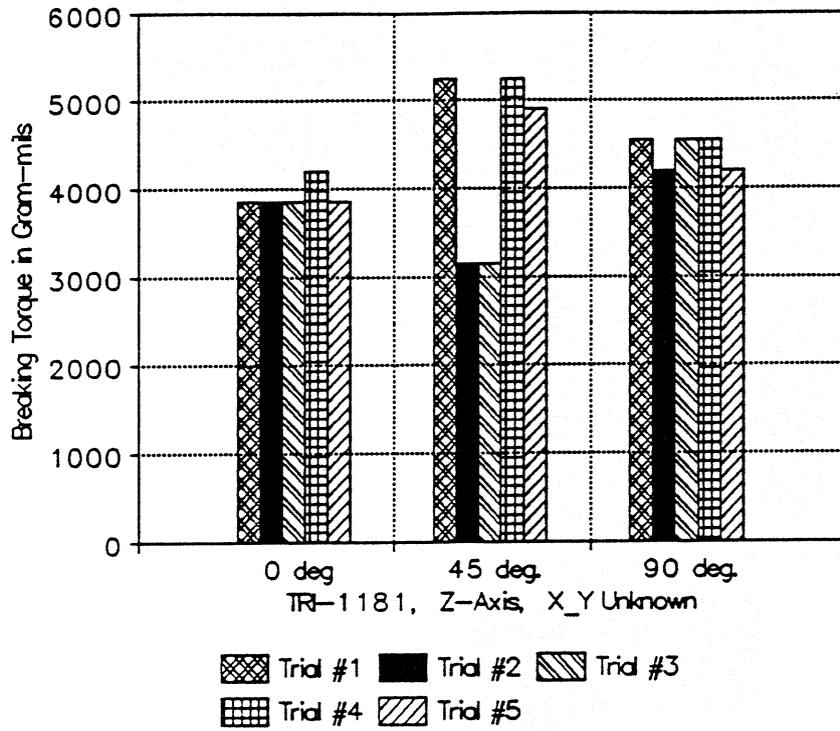


Figure 7

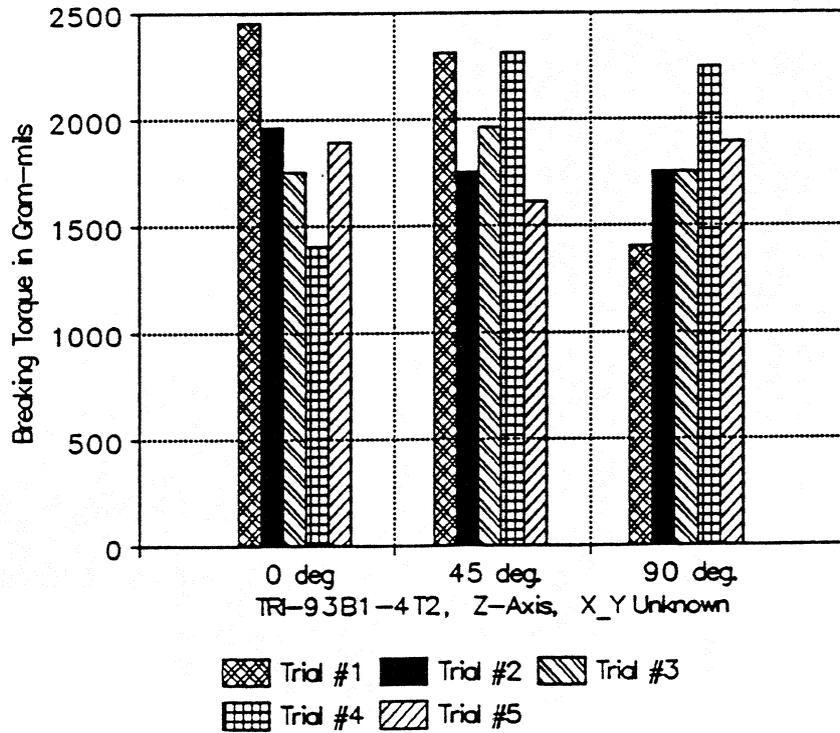


Figure 8

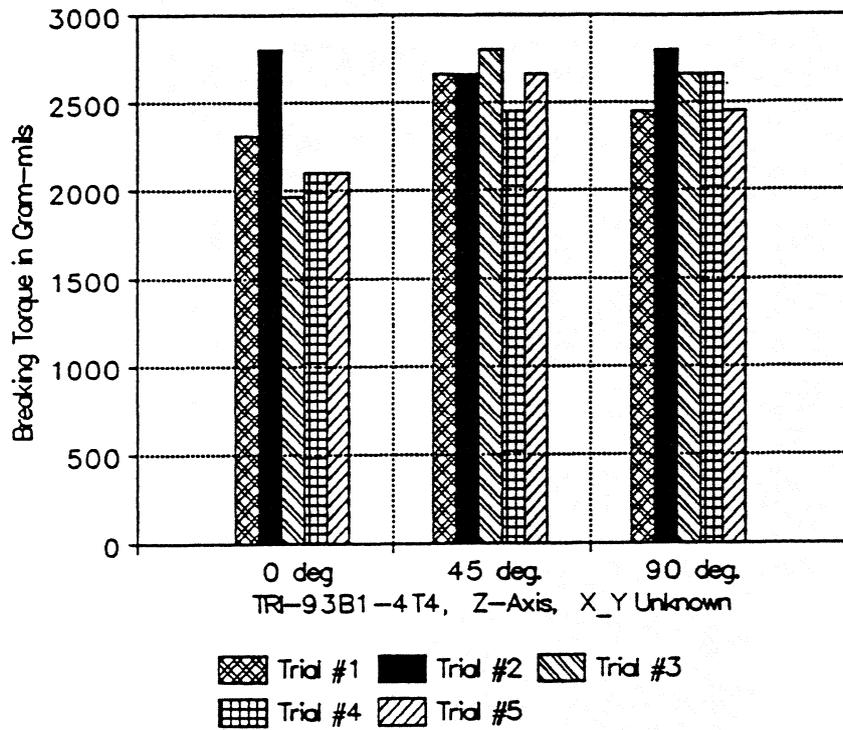


Figure 9

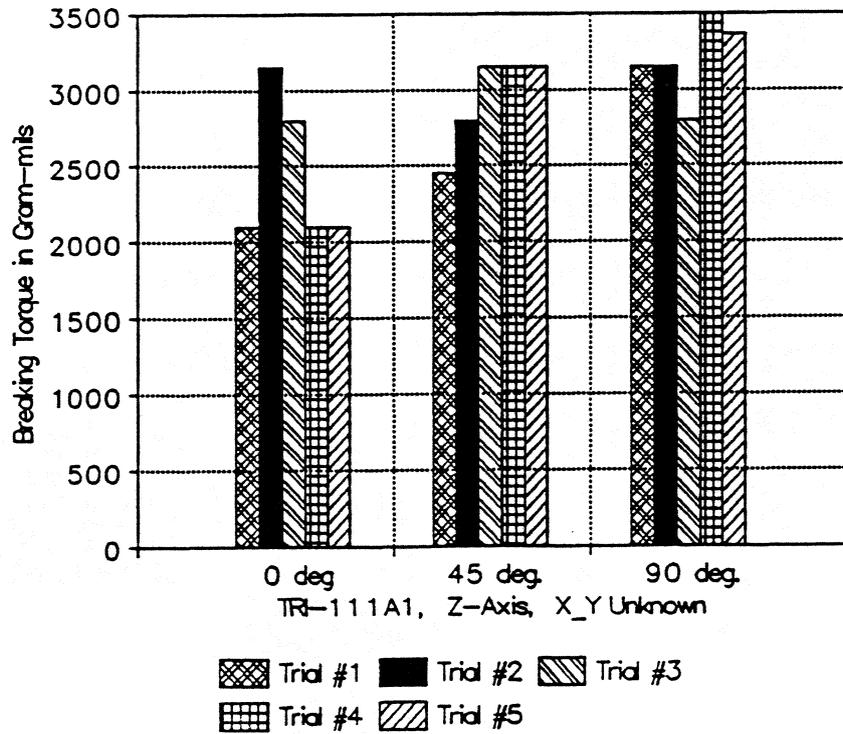


Figure 10