

GaAs Wafer Breakage Reduction

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Extended Abstract

GaAs wafer breakage has been accepted as a norm because of the extreme brittleness of wafers [1-3]. Historically, in the three inch wafer size days, 18 percent rate was not unusual. As the volume and size of the wafers grew, high rates became unacceptable. Today, using 150 mm (6 inch) wafers, the raw material cost has dropped significantly due to the high volume, but finished product wafer cost remains a challenge. Epi wafers are invariably used for commonly used III-V products, which are more expensive and the cost of a processed wafer goes up as it progresses through the fab process. Therefore, reduction of breakage is still a major issue. Breakage rates had settled down at about 2 percent in the last decade. The run rates are in thousands of wafer per week now. Fab yields are running around 95 percent and probe yields are approaching 99 percent. At a breakage rate of 2 percent, it is the highest Pareto item on the causes of yield loss. Skyworks has reduced breakage levels from a few percent to below 0.5 percent (measured as wafers broken as a fraction of wafer outs plus wafers broken). Fig. 1 shows the reduction of wafer breakage over a few years time. Fab wide initiatives and improvements to achieve this reduction are discussed in this paper. This rate does not include major operator errors that result in whole lot breakage. Only minor breakage defined as breakage of less than five wafers per event are included in the current study.

Our measurements have confirmed that incoming wafers are strong. Micro cracks are added during processing, the strength of processed wafers drops and routine wafer handling causes breakage. For a mature process that does not add scratches that reach a critical level during process, our data shows that wafer strength does not go down systematically and breakage rate does not go up as wafers progress through the fab. Rather, the wafer breakage is a function of process step and tool type. The wafer may break at the tool or later. Once attention is given to the main offenders and issues resolved, breakage goes down.

Few specific examples will be described.

References:

1. T. Cordner and B. Marks, "GaAs Breakage , Causes, Cures, Growth and Process", GaAs IC Symposium, 317, (1993)
2. S. Wdowik, "Reduction of Wafer Breakage in a 3" GaAs Wafer Fab Facility through the Implementation of a Biaxial Stress Test", GaAs MANTECH, (1990)

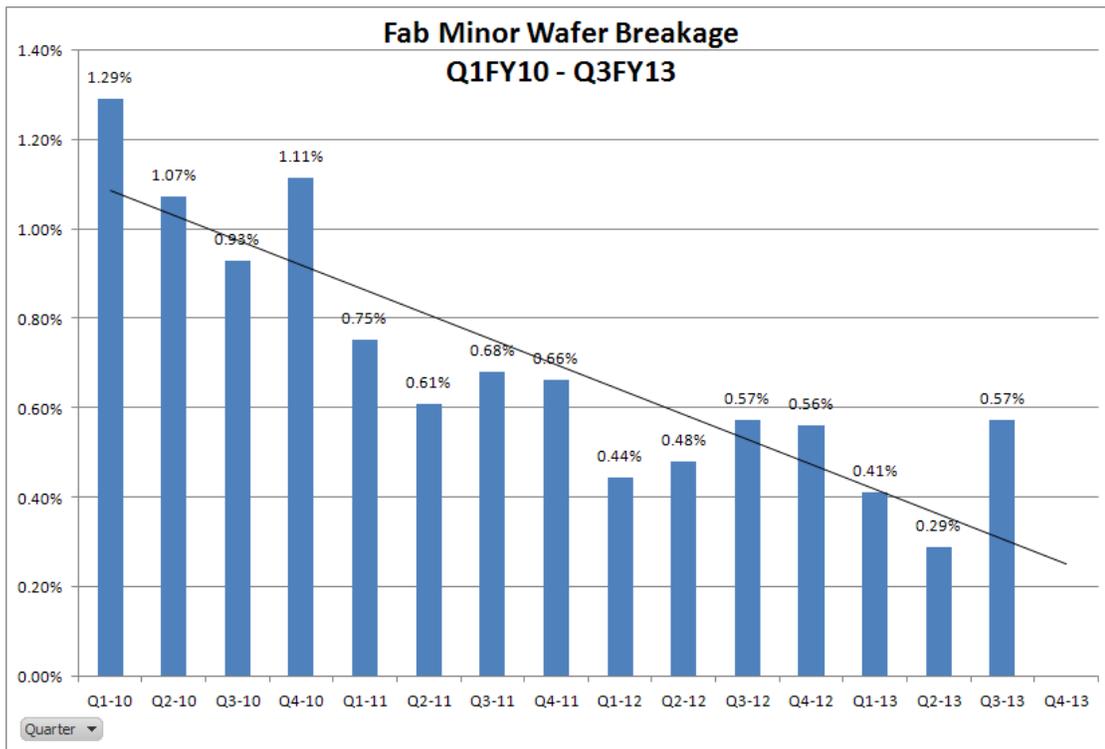


Fig. 1: Wafer breakage drop over the last few years at Skyworks.

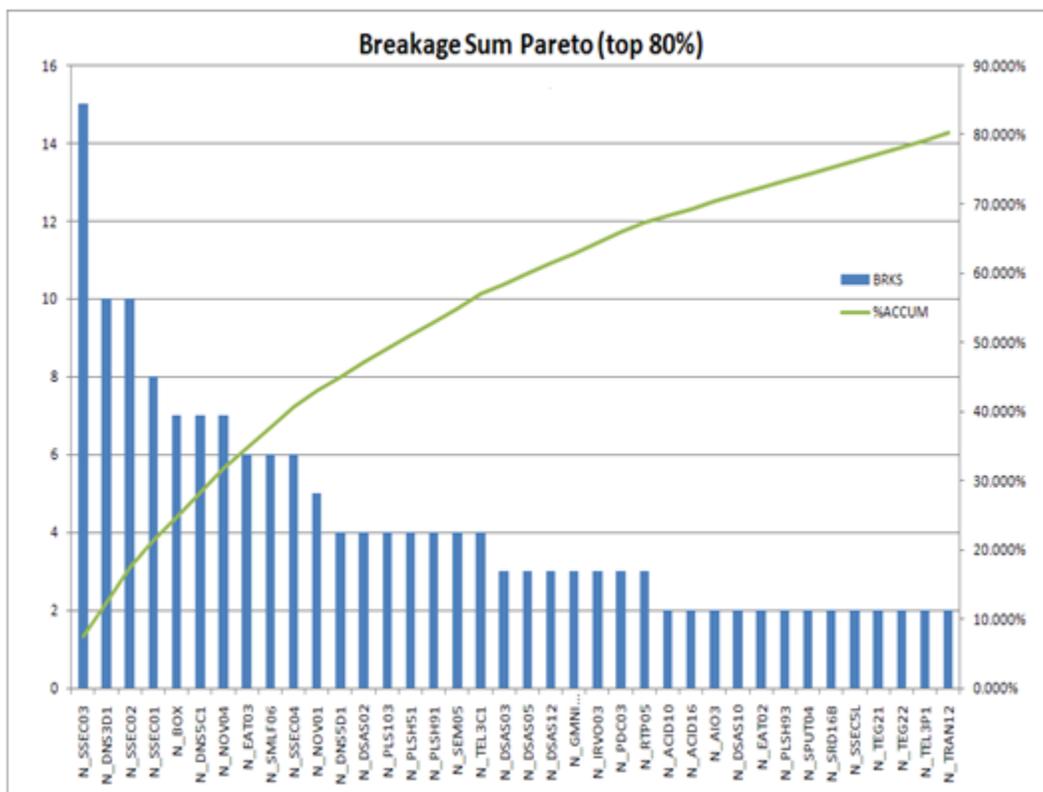


Fig.:2 Pareto of breakage by tool for one quarter