# Improvement of the reliability in magnetic tunnel junctions with annealing

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**Abstract**

Since the observations of large tunneling magnetoresistance (TMR) at room temperature, magnetic tunnel junctions (MTJs) have been paid much attention due to its high potential in the application of spintronic devices such as magnetic random access memory (MRAM) and read head. For the realization of those devices, it is highly required to study the reliability of magnetic tunnel junctions that have very thin tunnel barrier thickness less than 2 nm. In this paper, the time dependent dielectric breakdown (TDDB) of magnetic tunnel junctions under constant voltage stress as well as tunneling magnetoresistance (TMR) ratio and barrier properties (effective barrier height, thickness) was investigated as a function of annealing temperatures. The time to breakdown ($T_{BD}$) data were plotted with Weibull failure distribution. The $T_{BD}$ at the 63% cumulative failure fraction of as-deposited samples increased significantly after annealing at 210℃ while the TMR also increased from 8.85% (as-deposited) to 14.22% (annealed at 210℃). The improved reliability of magnetic tunnel junctions can be explained by the healing of bulk defects in the barrier during the annealing procedure. From the percolation breakdown model[1-2], the reduced bulk defect density can demand an elongated time to breakdown and suppress the initial defect generation rate in the barrier. The reduction of bulk defects in the barrier with annealing was also confirmed by the lowered 1/f noise power density from voltage fluctuation measurements.

## References

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