



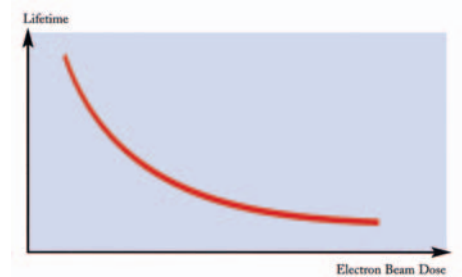
Advanced Applications

Electron Beam Processing of Semiconductors for Precision Lifetime Control

Electron beam processing is used as a reliable and reproducible method for tailoring switching speeds and recovery times of many silicon power semiconductor devices by reducing minority carrier lifetimes. The alternative conventional process used to control the carrier lifetime of such devices is gold or platinum doping.

The following devices are good candidates for electron beam processing:

- Fast Recovery Diodes
- Power Rectifiers
- Silicon Controlled Rectifiers (SCRs)
- Bipolar Junction Transistors (BJTs)
- Insulated Gate Bipolar Transistors (IGBTs)
- Gate Turn-Off Thyristors (GTOs)

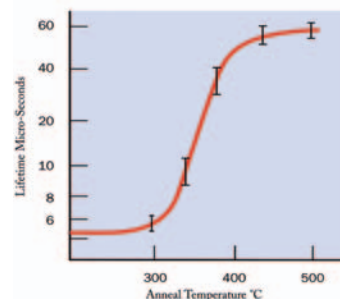


Electron Beam Processing

Electron beam processing is a method of modifying materials by bombarding them with a stream of high-energy electrons. An electron beam accelerator generates a continuous beam of electrons, which is scanned (swept) across a conveyor on which the product to be processed is placed. The resulting crystal lattice disruption affects the minority carrier lifetimes of the semiconductors, which improves the switching speed. The properties of the material after treatment depend on the absorbed dose from the electron beam.

Electron beam processing, which can be performed on metallized wafers or finished devices where testing prior to and after treatment is possible, has none of the shortcomings of doping. If devices or wafers are over-treated, they can be brought back to their required or original carrier lifetime values by annealing at or above 300°C.

EFFECTS OF ANNEALING AFTER ELECTRON BEAM PROCESSING (1800V DIODES)*



*Reference: R. O. Carlson, et al, IEEE Transactions on Electron Devices, Vol. ED-24, No. 8, 1977.

This is a very important feature of electron beam processing since devices annealed back to their original carrier lifetime values can be re-treated to obtain the correct value. Devices that have not reached the required carrier lifetime value can be further treated until the correct value is reached, because exposure to the electron beam process is cumulative.

Electron Beam vs. Doping

Electron beam processing offers some important advantages over doping:

- Electron beam is uniform and highly reproducible, whereas doping is sensitive to silicon defects that can hinder uniformity and reproducibility
- Electron beam allows the ability to electrically measure switching speed before and immediately after treatment, while doping is done too early in the manufacturing process to allow such testing.
- Electron beam is reversible, whereas doping is irreversible



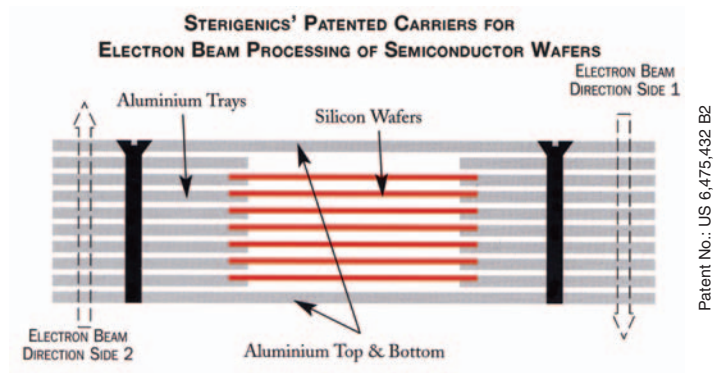
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Electron Beam Processing of Semiconductors for Precision Lifetime Control

Sterigenics' Unique Expertise in Electron Beam Processing of Semiconductors

Sterigenics has more than 30 years experience in providing electron beam processing services to major international power semiconductor manufacturers. This experience has led to several innovative refinements to the process, including patented designs for special product carriers. These and other innovations result in:

- Greater precision of dose delivered throughout stacks of wafers and across the wafers
- Improved, standardized and more convenient product handling
- Faster turn-around time



Sterigenics Advanced Applications Radiation Processing Capability

Sterigenics Advanced Applications offers electron beam service and development centers located worldwide:

- San Diego, CA
- Gaithersburg, MD
- Bridgeport, NJ
- Rayong Province, Thailand
- Espergaerde, Denmark
- Shanghai, China

We stand ready to work with the semiconductor industry to optimize and validate radiation processing protocols for their products, to increase performance specifications and reduce costs.