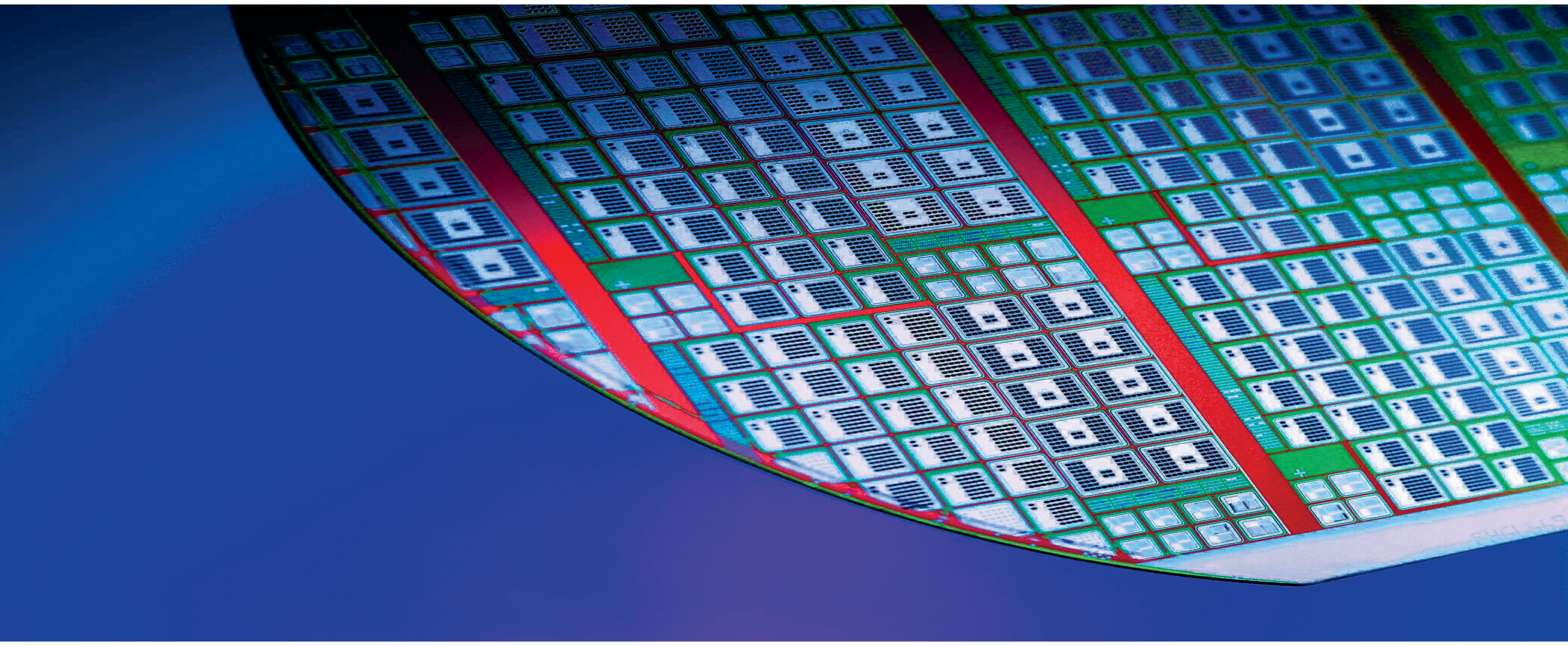
Semiconductor Laser Backside Annealing of Power Devices



IGBT wafer, courtesy Fraunhofer Institute for Silicon Technology (ISIT), Itzehoe, Germany

INNOVAVENT® LASER OPTICS

operated by JenLas® ASAMA Diode Pumped Thin Disk Laser

Semiconductor Laser Backside Annealing of Power Devices

Pulsed Laser Annealing of Power Devices and Backside Illuminated Image Sensors

Power Transistors like IGBT´s are manufactured on thinned wafers. To improve the ON resistance, wafer thickness is constantly reduced. Handling of these wafers is becoming more and more difficult. One solution is to bond the thinned wafers to a support carrier. However, the bonding materials are not compatible with the temperatures of annealing and activation processes.

The way out of this dilemma is the implementation of pulsed laser annealing. Due to the short pulse duration in the range of 1µs, pulsed laser annealing allows to achieve process temperatures on the exposed surface and simultaneously avoiding excess temperature levels on the bonded surface.

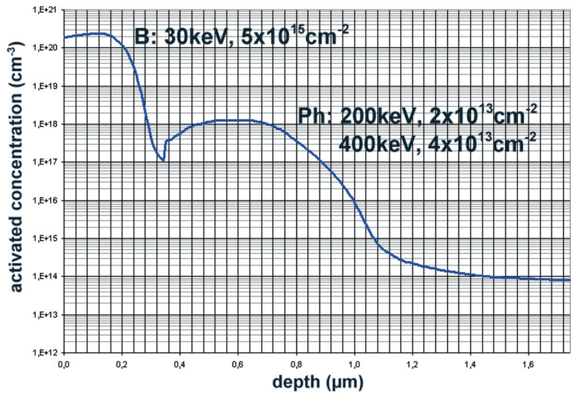
For other vertical power semiconductor products which have metal contacts on the front side, pulsed laser annealing reduces the number of process steps. The front side can be fully processed, including metal contacts, and the back side is annealed with pulsed laser radiation afterwards. The short pulses keep the temperature on the front side low and the metal contacts intact.

Backside illuminated image sensors are another example which benefit from pulsed laser annealing. A shallow implant layer on the surface can be activated while keeping buried structures like photodiodes and metal contact layers fully intact.

The INNOVAVENT Pulsed Laser Annealers

The INNOVAVENT VOLCANO and LAVA systems both use the proprietary JenLas® ASAMA thin disk laser. They are designed to create highly uniform laser lines to scan the wafer surface. Besides high uniformity, the JenLas® ASAMA laser allows to program the pulse duration. By optimizing duration and energy density of the laser pulses, depth and temperature of the activation process can be precisely controlled. The result is a very high flexibility of the activation process, combined with high stability and uniformity. Dopant activation at 2 µm depth has been demonstrated.

Throughput depends on process parameters and installed laser power. More than 60 wafers/h can be realized.



SRP profile of combined B and P implantation for IGBT´s (courtesy Fraunhofer Institute for Silicon Technology, Itzehoe, Germany)

	VOLCANO 80/160 semi IGBT	VOLCANO 80 semi IMAGE SENSOR
wavelength/nm	515	515
laser power/W	80 or 160	80
laser line size	up to 6mm x 40µm	36mm x 6µm
process duration/ns	300- 1200*	300 - 1200
energy density/J/cm²	variable, up to 4	variable, up to 2.5
throughput	up to > 60 wafers/h (6“)	up to > 60 wafers/h (6“)

* up to 3 µs with 160 W dual ASAMA configuration

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