INNOVAVENT®

Semiconductor Laser Annealing

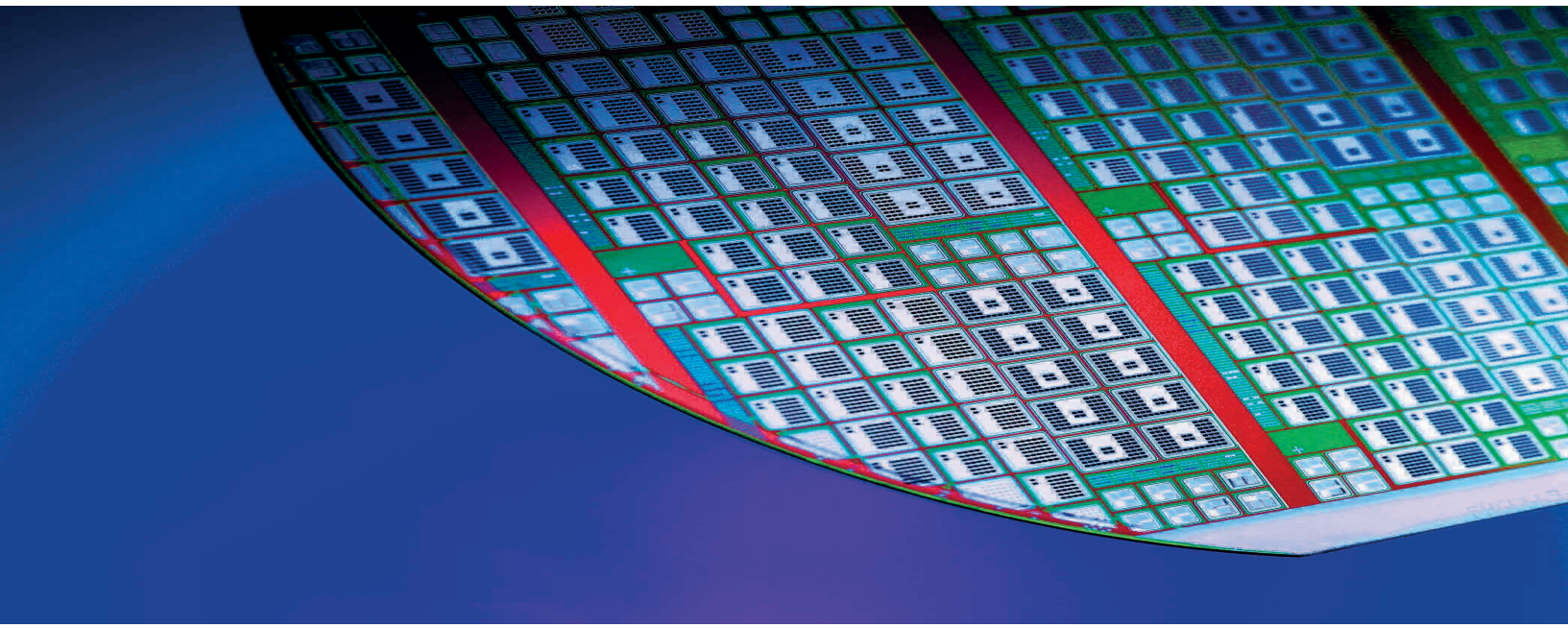


Photo: IGBT wafer, courtesy Fraunhofer Institute
for Silicon Technology (ISIT), Itzehoe, Germany

INNOVAVENT® LASER OPTICS

Semiconductor Laser Annealing

Pulsed Laser Annealing of Power Devices and Backside Illuminated Image Sensors

Pulsed green Laser Annealing was successfully used to produce 1200V/200A Field Stop Trench IGBTs of a custom-designed **Integrated Traction Inverter** for an E-Mobility Drive. The total switching loss of the power modules could be reduced by 50% compared to a reference module[1,2].

IGBTs for a voltage range of 600V to 1200V typically require 60µm to 140µm thin silicon. The implanted IGBT backside also requires dopant activation. A furnace annealing process at high temperature (> 900°C) is prohibited as thin wafer might be mechanically stabilized by temporary bonding it to a carrier wafer using a polymer film with damage threshold >180°C.

Short laser pulses of <1 µs is the suitable solution to provide a high process temperature which is strictly localized within the laser spot and thus prevent the temperature from exceeding the damage threshold for the bonding layer and the wafer front side. Short laser pulses keep the temperature on the wafer front side low and the front-side 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 sensors and metal contact layers fully intact.

Ohmic contact formation on SiC completes the list with a further successful application.

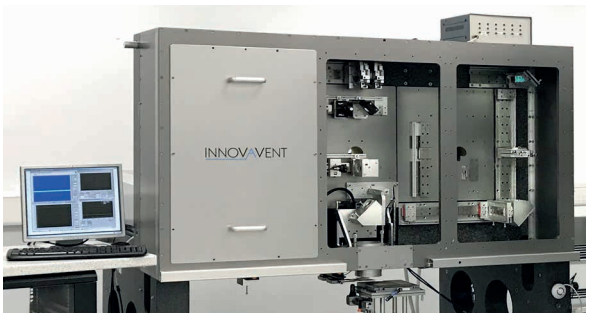
1) PCIM Europe 2018, 5 – 7 June 2018, Nuremberg, Germany
Ulf Schümann et al., ISBN 978-3-8007-4646-0,
VDE VERLAG GMBH · Berlin · Offenbach, pp. 103-110, (2018)

2) BMWi Verbundprojekt InMove , funding reference 01MY15001B,
Fraunhofer ISIT, Itzehoe, Germany

INNOVAVENT VOLCANO Laser Optics

The new **INNOVAVENT VOLCANO semi** Laser Optics are available for the green wavelength (532/527nm) and combining IR (808nm) and green lasers. The temporal profile is controlled by delay control of two green laser pulses for optimizing the activation depths from about 0,1µm to 2µm. The dual wavelength version with a combination of infrared and green lasers provides the activation up to a 3,5µm depth. Both system configurations offer a unique flexibility due to independently variable pulse durations of IR and green. Various additional parameters like laser intensities and scan speed can be widely adjusted for a precise process optimization. Processing of semiconductor devices can be optimized easily by selecting pre-programmed recipes.

VOLCANO semi Laser Optics configurations are available for other applications like contact formation on SiC wafers as well.



INNOVAVENT VOLCANO semi IGBT system set up in the Application Lab

Options and features

Process Shutter, Beam Profiler, Pulse Delay Setting, Melt Monitor, etc.

	VOLCANO semi IGBT	VOLCANO semi IGBT Dual Wavelength
application	shallow and medium depth dopant activation, SiC contact formation	dopant activation beyond 2µm
wafer size	depending on wafer handler	
wavelength	532nm (or 527nm)	532/527nm and 808nm
laser line size	7.5mm x 30µm	5mm x 30µm
process duration (pulse delay length)	300ns - 1200ns	300ns - 1200ns (532/527nm), 10µs - cw (808nm)
energy density/power density	variable, up to 5J/cm²	variable, up to 7J/cm² (532/527nm), variable, up to 50kW/cm² (808nm)
pulse repetition rate	10kHz	10kHz

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