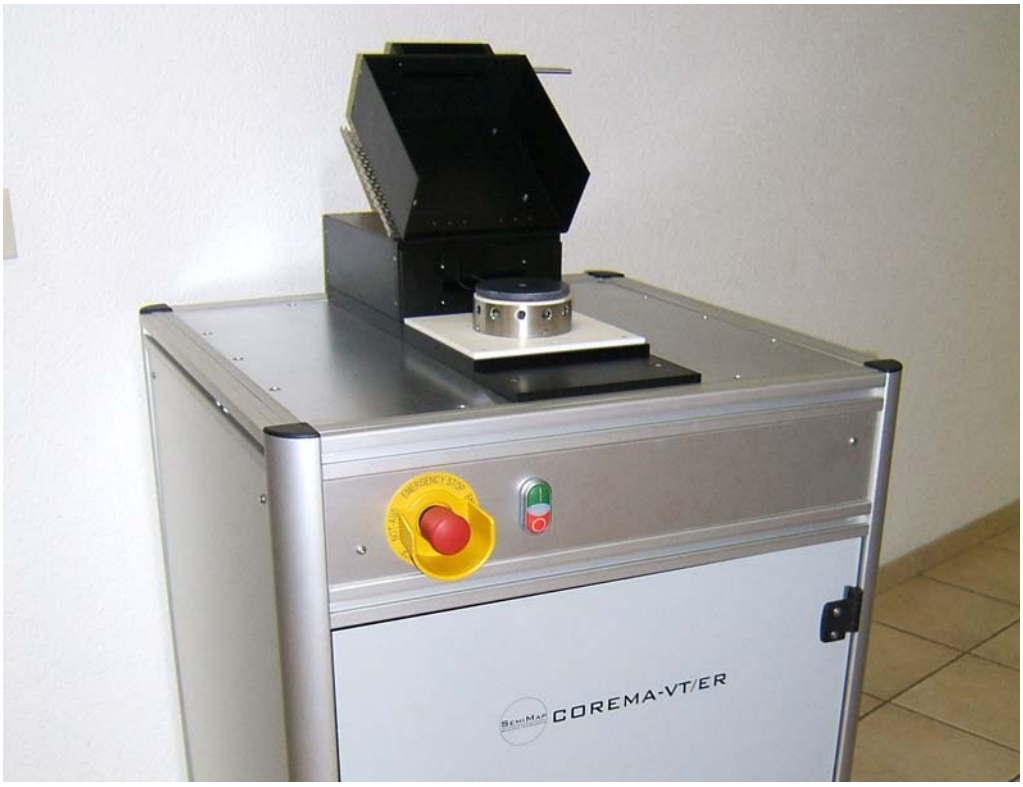
COREMA - *VT*

Contactless Resistivity Evaluation at Variable High Temperature

Version 2-2011

The technology to grow bulk, semi-insulating SiC, Cd(Zn)Te and GaN single crystals is highly demanding. Various compensation schemes, requiring precise control and assessment of the participating intrinsic defects, intentional dopants and unintentional impurities, are under investigation and development. Different approaches are pursued and material quality is improving and adapting at a rapid pace to ever-increasing specification and quality requirements of the customers . In order to obtain reproducible resistivity values, the activation energy determined by the compensation process must be tightly controlled. The most convenient way to do this is to measure resistivity at Variable Temperature and to deduce an Arrhenius plot.

Also, customers generally request a minimum resistivity at a specified elevated temperature, to be verified by the vendor.

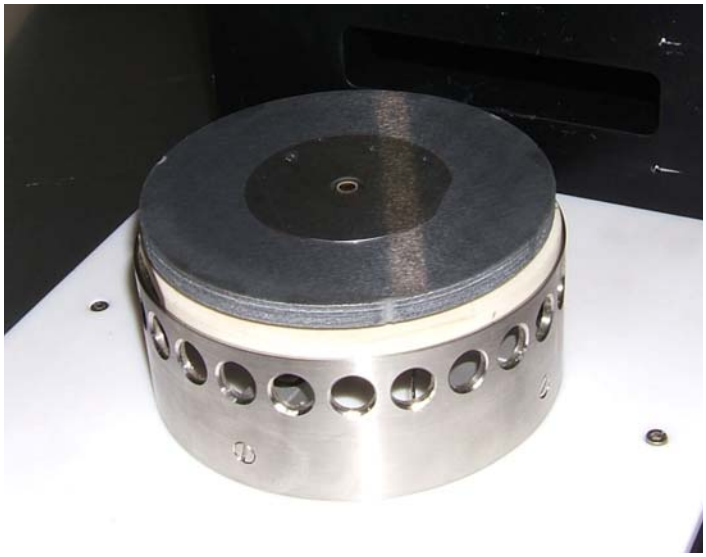


COREMA-VT measurement system

COREMA – VT has been developed to meet these demands. A fully automated temperature adjustment, resistivity measurement and Arrhenius plot data evaluation is provided. As is common to SemiMap instrumentation, the procedure is non-destructive and noncontacting. No sample preparation is needed - not necessarily, but as a convenient option, standard production wafers are analysed and thereafter used for other purposes. The individual sampling at each specific temperature is very rapid, such that the measurement time is determined by the temperature scanning alone.

The high performance SiN heater plate unit is placed in a compartment providing thermal insulation and illumination shielding. The latter is necessary to avoid falsification by photoinduced conductivity. The 6 mm diameter annular capacitive probe is assembled in a central bore of the heater plate.

The high performance ceramic heater plate allows rapid heating of the sample at selectable rates and up to 400 ^{0}C. The heating power is supplied by a programmable source allowing precise control of the temperature cycle monitored by a thermocouple sensor which is placed directly adjacent to the capacitive probe. A second compartment behind the heater compartment is equipped with a computer controlled exhaust ventilator to adjust the cooling rate.

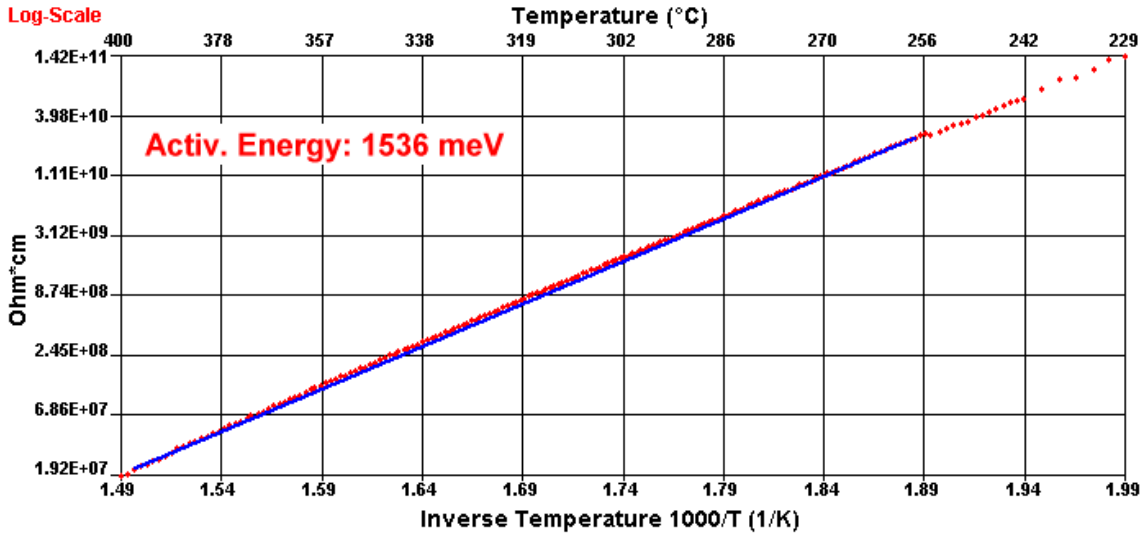


Integrated COREMA-VT heater and sensor unit

A typical measurement cycle comprises heating in the dark, whereby eventual persistent photoconductivity is detected, analysed and removed, followed by slow cooling in the dark while resistivity is measured consecutively. The data are displayed in the form of an Arrhenius plot and the activation energy is evaluated by best fitting.

If (as shown below) in the Arrhenius plot is linear, the Fermi level does not depend on temperature, i.e. is securely pinned to the compensation level. Curved Arrhenius plot result from shifting of the Fermi level with temperature, indicating unstable compensation wherein different defect levels are participating.

Hence COREMA-VT is a powerful tool not only for routine control of specifications, but also for in-depth analysis of exploratory material development.



Arrhenius plot of s.i. SiC substrate resistivity

For more information contact

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Specifications

Mechanical Setup

Components	
Ceramic heating stage	Specially developed for COREMA-VT
Built-in capacitive sensor	High temperature compatible development
Light tight measurement box	
Exhaust ventilator controlled	Computer and sample temperature

Specifications	
Sample loading	Manual
Sample thickness	250 – 1000 µm
Wafer diameter	2” to 150 mm
Temperature range	RT to 400 ^{0}C
Heating speed	2 ^{0}C/s max
Forced air cooling	ca. 10 ^{0}C/min

Measurement System

Components	
Charge amplifier	Specially developed
Digitizer	*adapted OEM*
Pulse Generator	*adapted OEM*

Specifications	
Sensor	6 mm diameter
Lateral resolution	8 mm
Minimum sample size	10 mm diameter
Minimum distance of sensor center to edge of sample	4 mm
Repeatability of ΔE evaluation (4 consecutive measurements)	< 2 %
Resistivity range	1x10^5 – 1x10^{12} Ωcm
Arrhenius plot evaluation time	about 30 min

Measurement Control

Components	
Computer	Pentium PC with CD-RW and NIC – Microsoft Windows
Software	Custom Windows based measurement control and evaluation program

Specifications	
Operation	User-friendly menu-driven selection and control of measurement routines