# Compound Semiconductor Wafer Characterisation (I)

EURORAD

## Contactless Resistivity Mapping of Semi-insulating Materials

## (CdTe, CZT, GaAs, InP …)

The homogeneity of the compound semiconductor wafers of high resistivity determines the production yield, and, therefore, the production cost for industry. Thirty years of experience in the field of growth and characterisation of semi-insulating compound semiconductors have helped us to develop the best suited instruments for both research and industry.

For determination of the resistivity over large area high resistivity semiconductor wafers, a non-contact method is mandatory, to avoid any modification of the material afterwards during the contact processing.

### *Materials to be characterised*

| * Compound high resistivity semiconductors, especially: | * Resistivity domain: | * Wafer size: |
|---|---|---|
| - Cadmium Telluride (CdTe)<br>- Cadmium Zinc Telluride (CZT)<br>- Gallium Arsenide (GaAs)<br>- Indium Phosphide (InP)<br>- ………………….. | $10^5$ to $10^{11}$ $\Omega \cdot$ cm | ϕ 50 mm (2'') as standard<br>and more on request;<br>minimum thickness 500 μm |

### *Principle of the method*

The resistivity mapping instrument uses a contactless, consequently, non destructive method, called «Time Domain Charge Measurements» (TDCM)*. The sample is placed into a capacitor as a lossy dielectric substance (see photo below) and the resistivity is evaluated by measuring a time dependent charge transient observed after application of a voltage step. The measurement is non-contacting, i.e. avoiding the problems connected with the fabrication of ohmic contacts. It allows the examination of wafers without degrading surface quality.

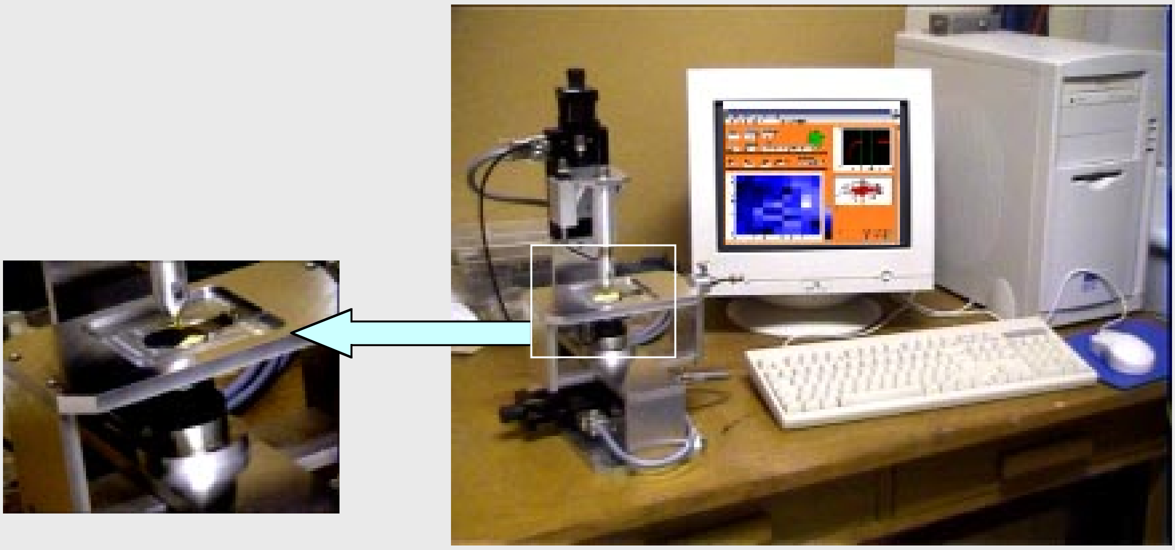

*Fig. 1. Photo of the resistivity measurement system.*

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* This method is based on an approach proposed by R. Stibal et al. (*Semicond. Sci. Technol.* 6 (1991) 995-1001).

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## Contactless Resistivity Mapping...

A spatial resolution of 1 $\text{mm}^2$ and excellent reproducibility have been achieved. Single measurement takes only few seconds and the real time result can be observed on a computer screen (Fig. 2).

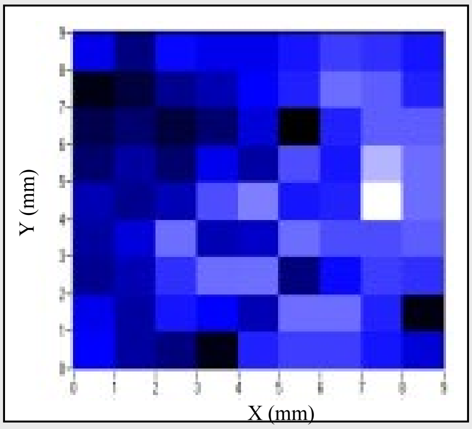

*Fig. 2. Real time resistivity mapping of 10x10 $\text{mm}^2$ semi-insulating wafer.*

The appropriate software allows also real-time observation of  charge distribution as a function of time (see Fig. 3) as well as 3D representation of the measured sample resistivity (Fig.4).
Fig. 5 shows the examples of resistivity mapping of two 100 $\text{mm}^2$ CdTe wafers.
The results are independent of sample thickness.

**The instrument presented here allows systematic, rapid, non-destructive and low cost system for routine estimation of resistivity of semiconductor materials before their any further application.**

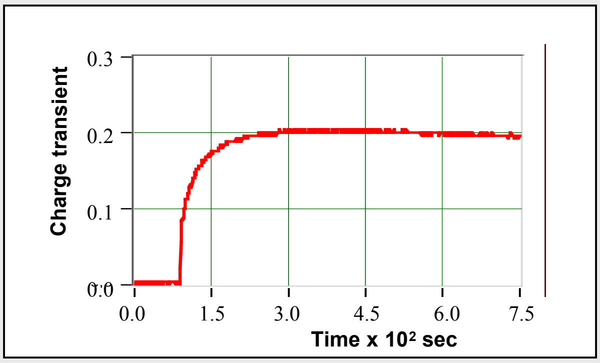

*Fig. 3. Time-dependent charge distribution after a voltage step.*

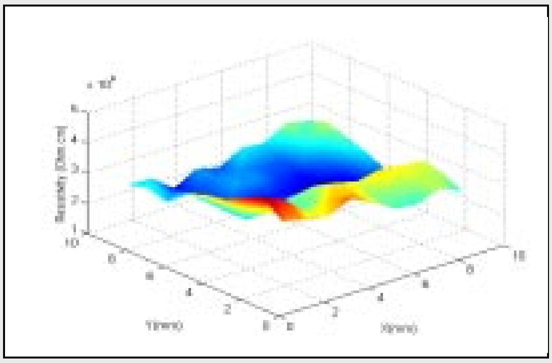

*Fig. 4. 3D mapping of sample resistivity.*

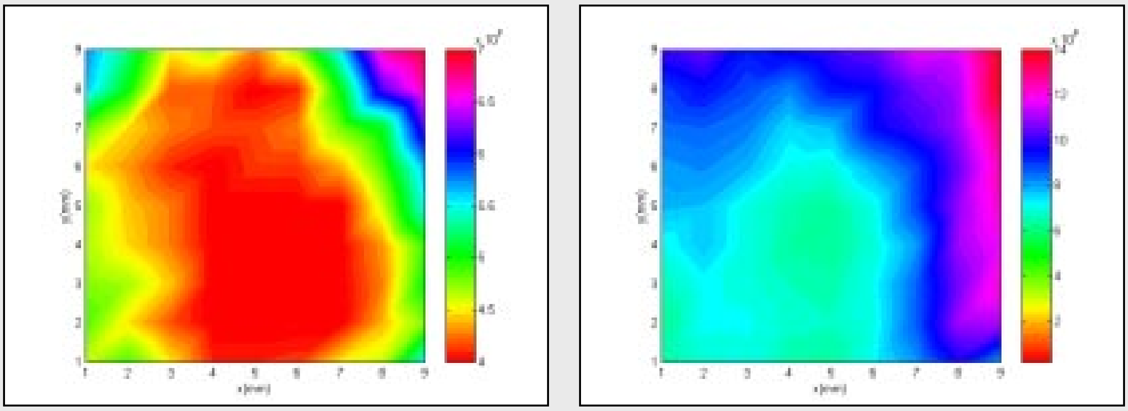

*Fig. 5. Colour-coded maps of 2 CdTe wafers (10x10x2 $\text{mm}^3$) resistivity.*

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