Technique d'Imagerie et de Profils de Dopage en Champ Proche (TIPDoC)

Doping Profile Near Field Electrical Characterization

Doping profile validation

Validation de la méthode de détermination des profils de dopage:

- application of the TLM resistance measurement method*

  *Transmission Line Measurement : http://tuttle.merc.iastate.edu/ee432/topics/metals/tlm_measurements.pdf
- at levels deeper and deeper by etching (Reactive Ion Etching ,RIE) of the implanted silicon
- to determine the value of the profile of the resistivity within the implanted layer of silicon

J-L. Perrossier
CTU-IEF

d'après la méthode proposée par Francesca CHIODI
IEF Université Paris-Sud

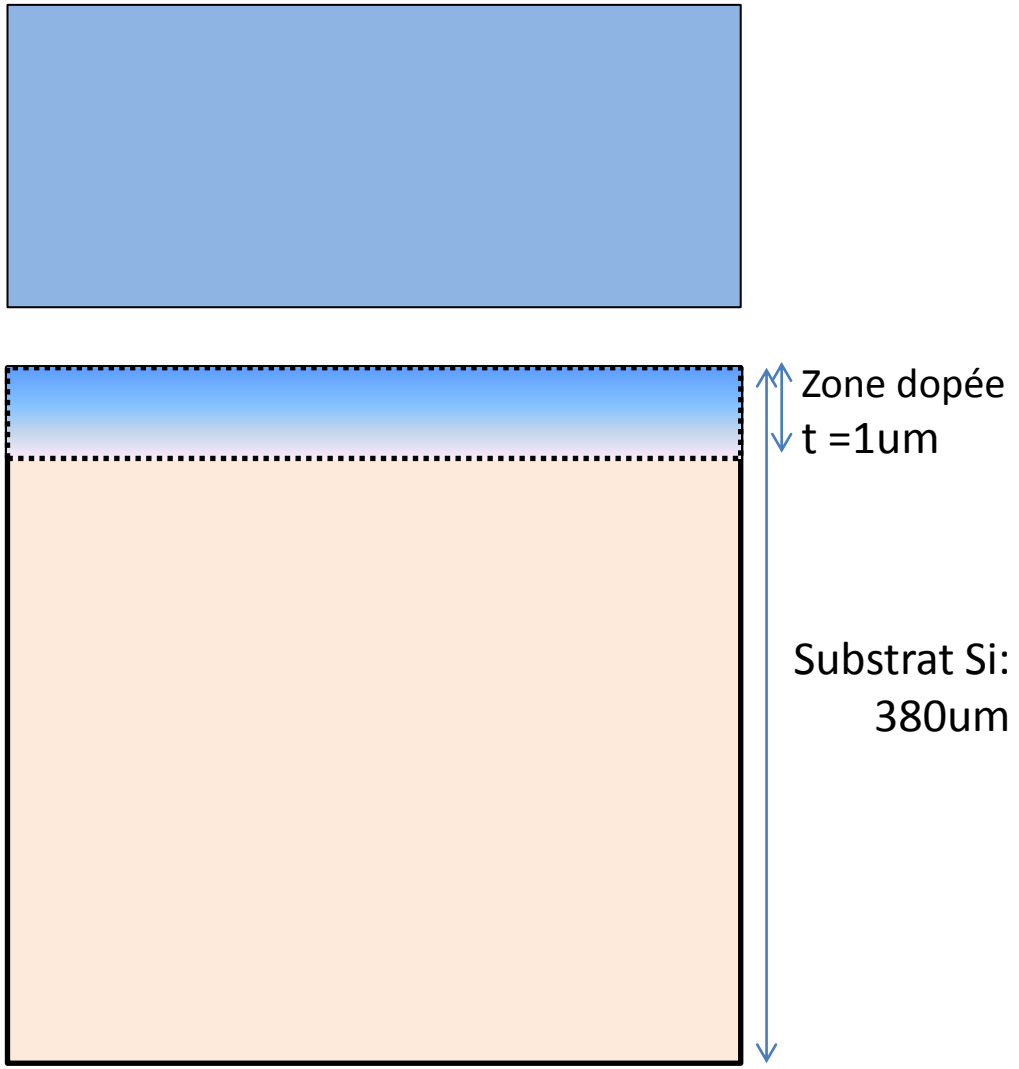
Implanted sample

Échantillon avec implant

- **Implanted sample**
- **Ultrasonic cleaning** (1)
- Photoresist coating
- Photoresist opening
- Wet etching(2)
- Al deposition
- Al Lift Off
- Profile measurement
- I-V measurement
- Reactive Ion Etching

} n times(3)

1. Ultrasonic cleaning
   - Acetone, 5 mn
   - Isopropanol, 5 mn
   - Drying: GN_2
2. Wet etching (just 10 mn before introduction in the deposition vacuum chamber)
   - BHF 30-60s
   - Rinse DIW
   - Drying: GN_2
3. n >= t / 200nmTime ≥ n x 7 mn



Photoresist coating/Enduction de résine

S1813 / 4000 rpm / 30s

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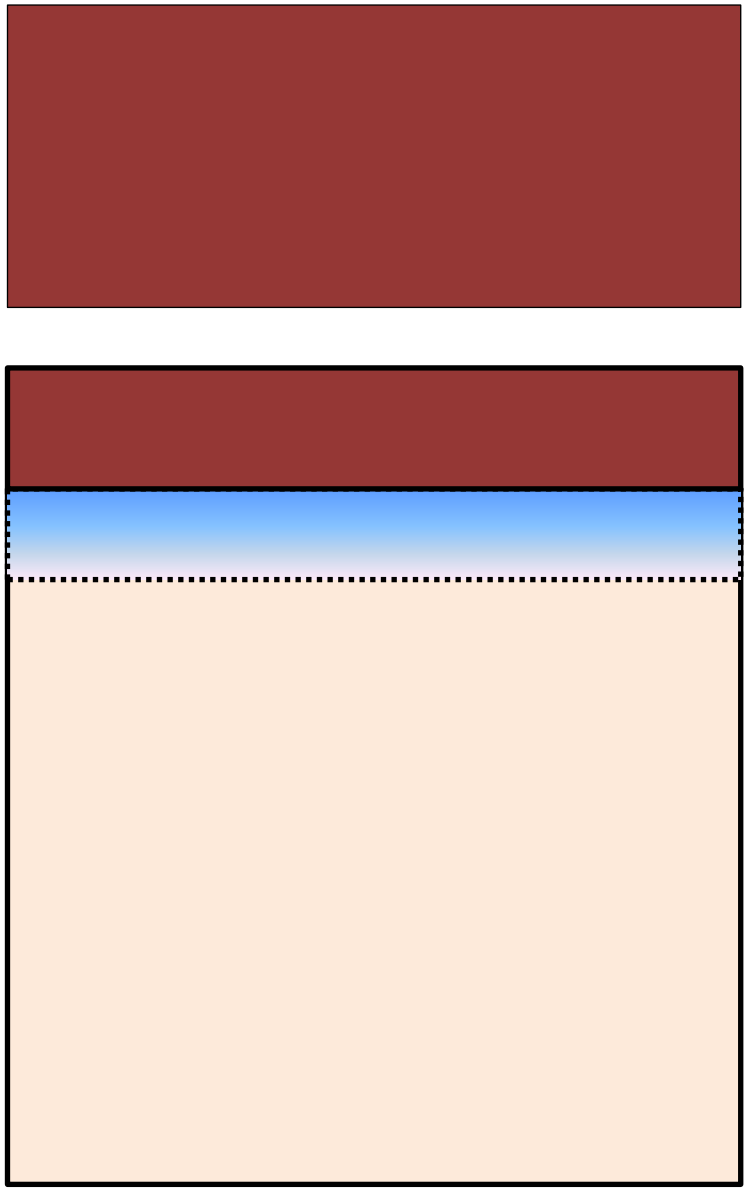

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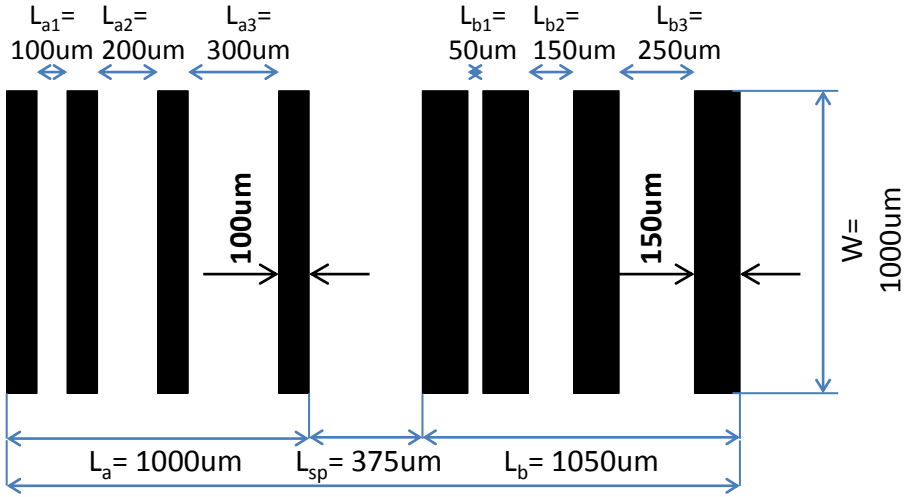
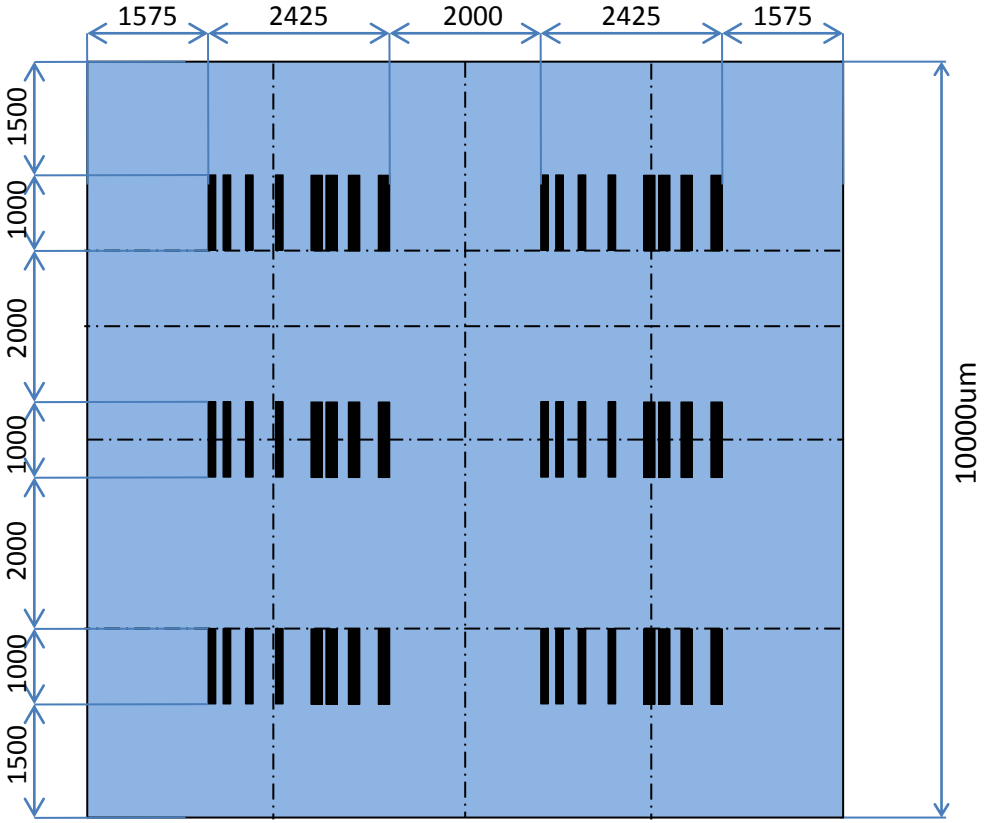
Mask: Direct laser writing

Mask

- W>>L (W/L ~ 2-3)
- L_i>t



Layout on a 10mm square piece of silicon



Photoresist opening

- Implanted sample
- Ultrasonic cleaning (1)
- Photoresist coating
- **Photoresist opening**
- Wet etching(2)
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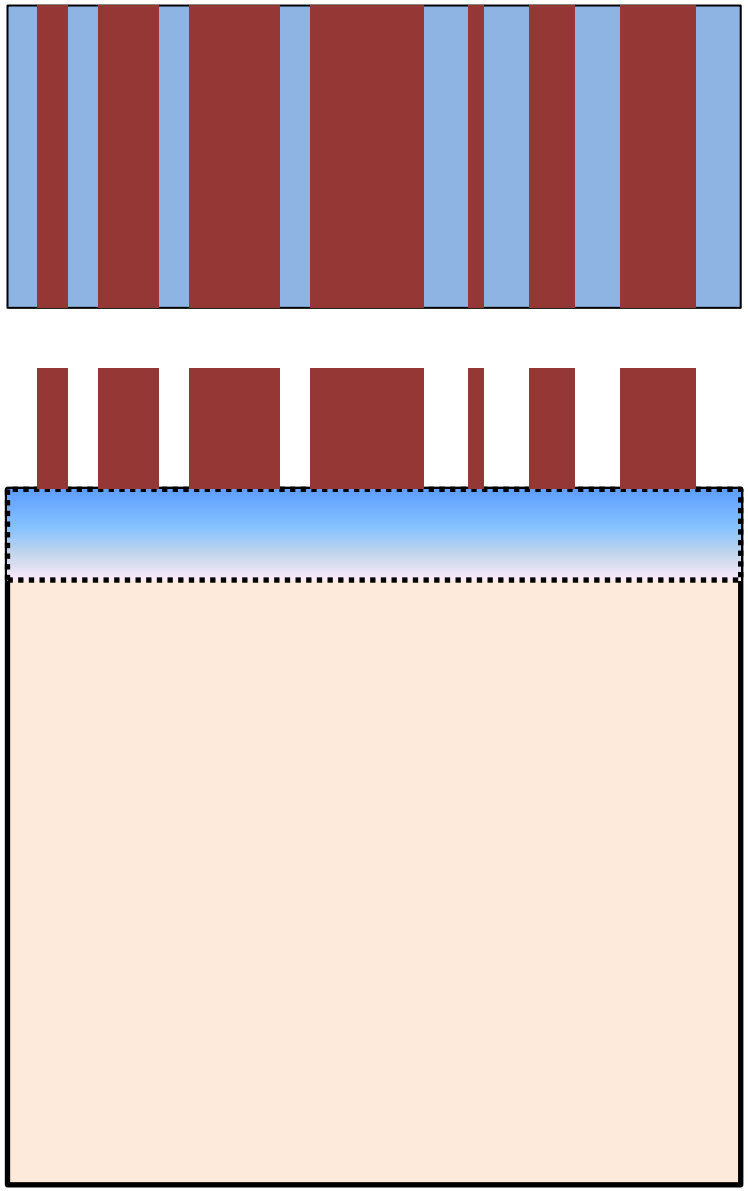

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Aluminium deposition : 300nm , Plassys

(immediatly after wet etching BHF 30-60s)

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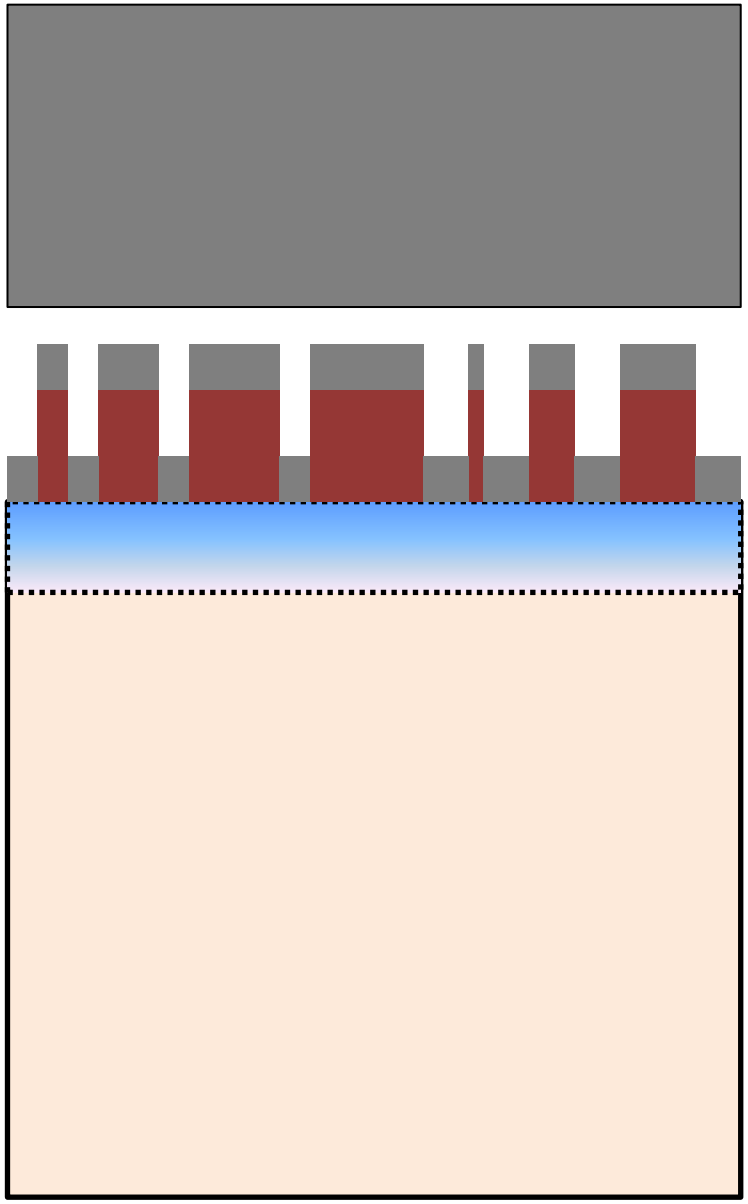

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Aluminium Lift Off

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- Wet etching(2)
- Al deposition
- **Al Lift Off**
- Profile measurement
- I-V measurement
- Reactive Ion Etching

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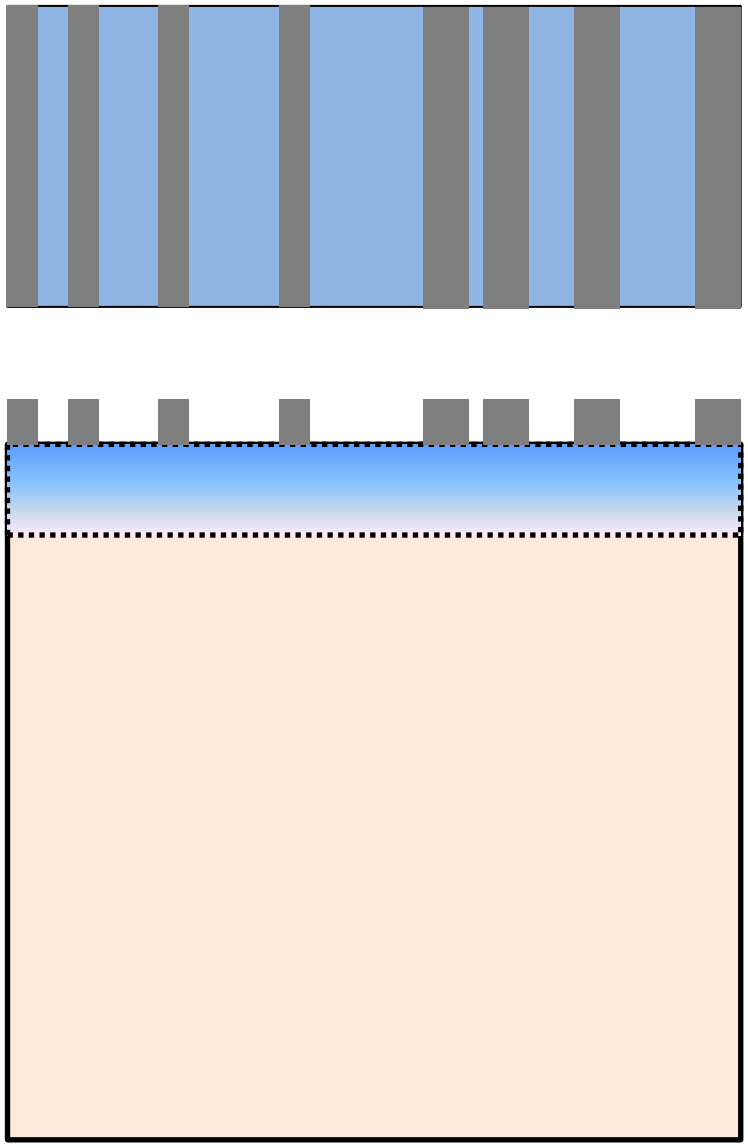

Reactive Ion Etching of implanted silicon*

- Implanted sample
- Ultrasonic cleaning (1)
- Photoresist coating
- Photoresist opening
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- **Reactive Ion Etching**

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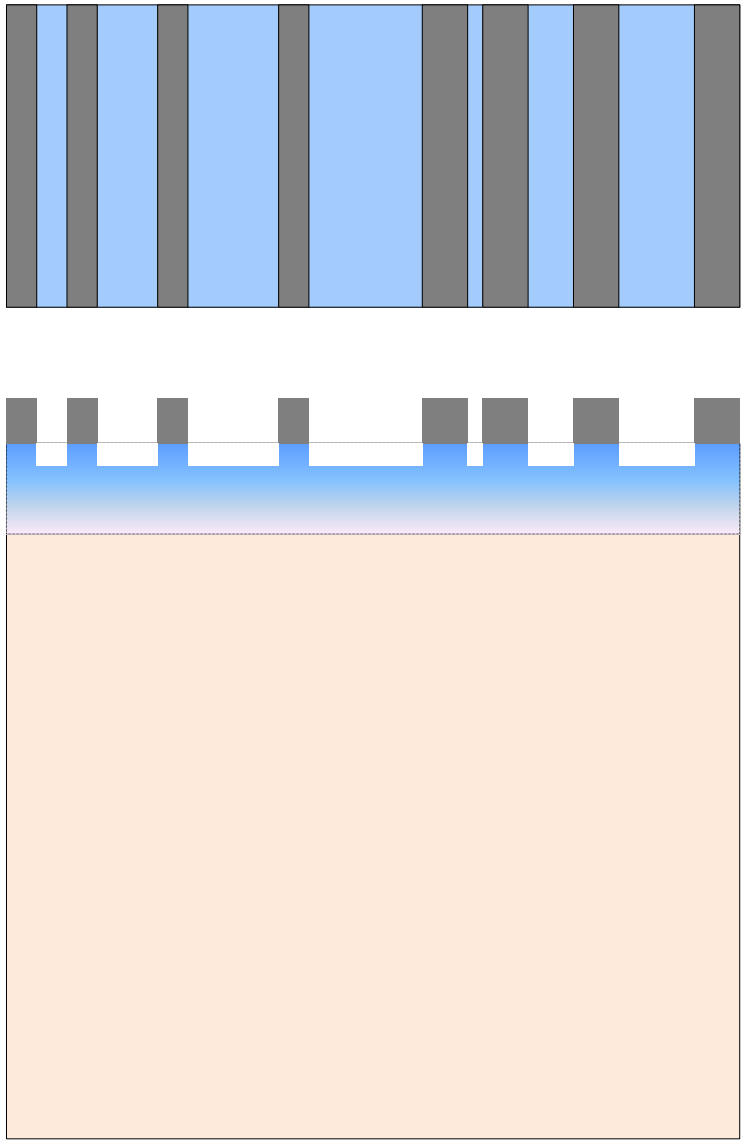

*gravure RIE enseignement
ou RIE AV
voir recette J-R. Coudevylle/X. Le Roux

Reactive Ion Etching of silicon*

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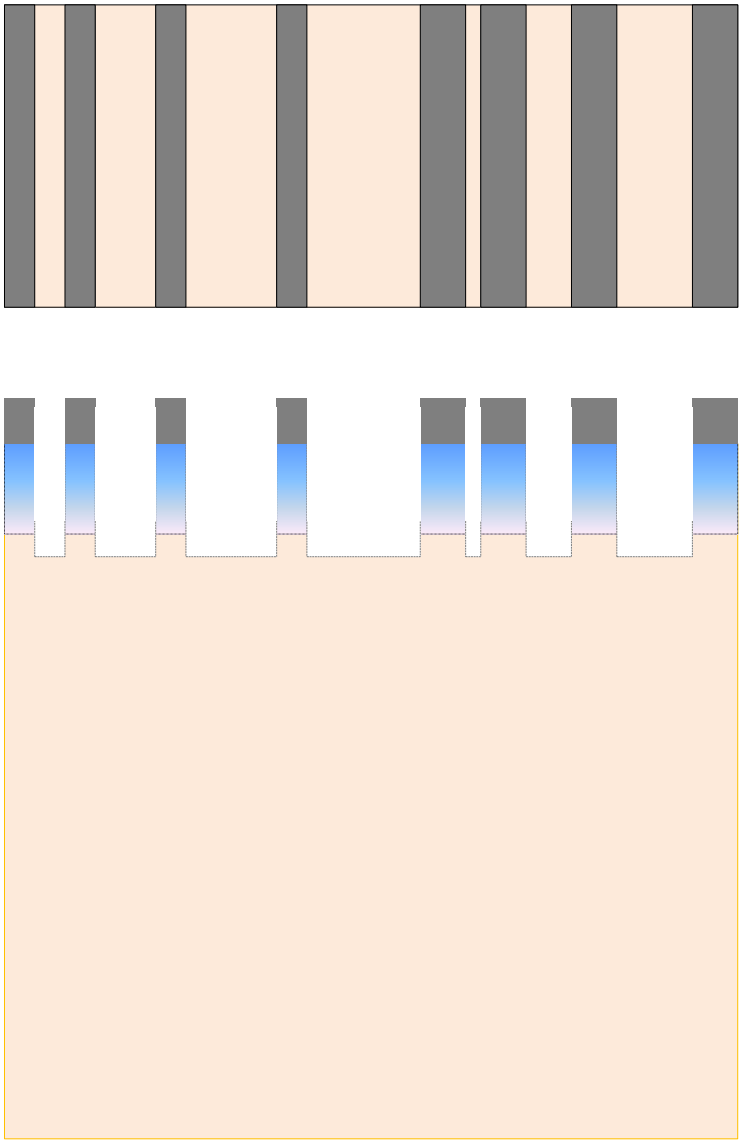

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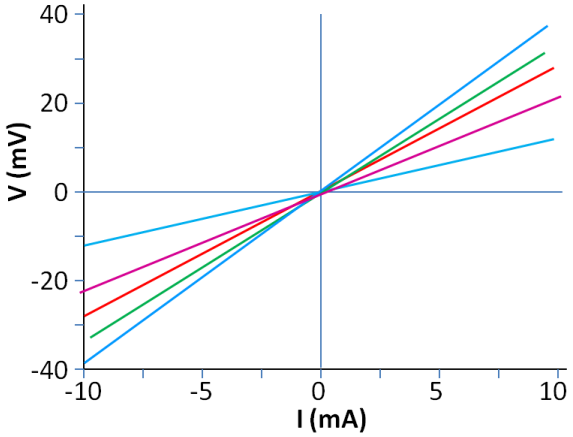
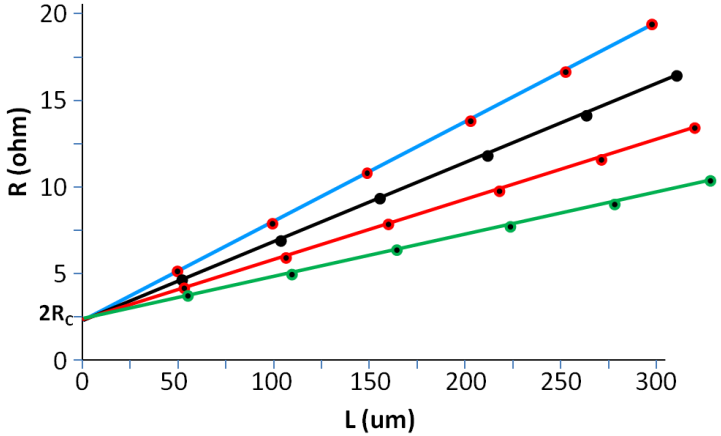
TLM method

I-V measurements at one depth for different lengths



R=f(L) at various depths



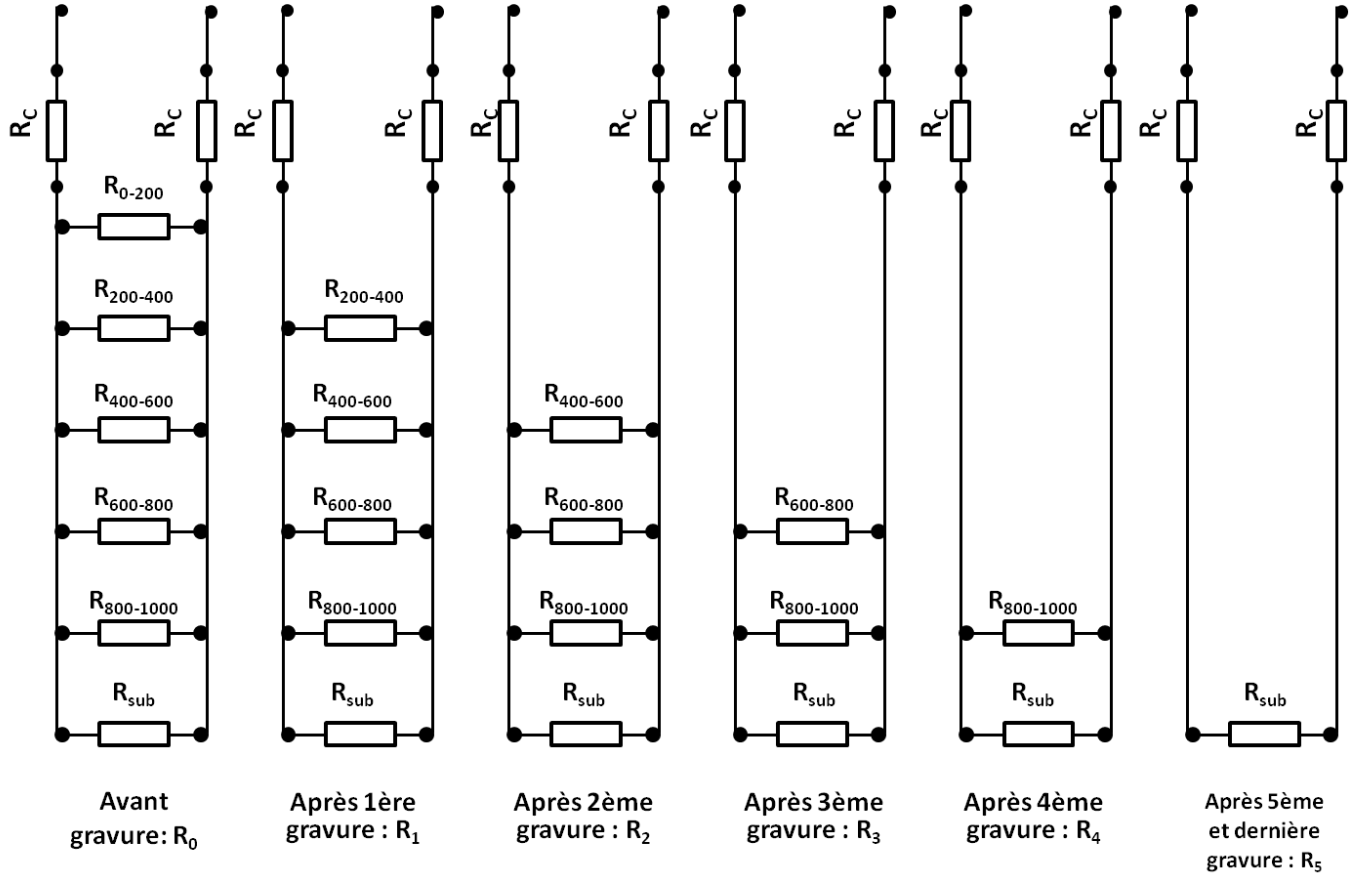
$$R = {}^{V}/_{I}$$

$$R = 2\,R_c + R_l = 2\,R_c + \rho_l \frac{L}{t_l\,W}$$

R_c : ohmic contact resistance of aluminium/silicon surface
R_l : resistance of the layer between 2 contacts separeted by a distance of l

Resistance in-depth measurement (TLM method) in trenches obtained by Reactive Ion Etching

$$R = 2\,R_c + R_l = 2\,R_c + \rho_l \frac{L}{t_l\,W}$$



Example : etching steps of 200 nm in a sample with an implanted depth of 1µm

$$\rho_{sub} = (R_5 - 2\,R_c)\,\frac{t_{sub}\,W}{L}$$

$$\rho_{800-1000} = \frac{(R_4 - 2R_C)\,R_{sub}}{R_{sub} - (R_4 - 2R_C)}\,\frac{W}{L}\,200$$

….etc..