Hands-on Guided Solar Cell Fabrication

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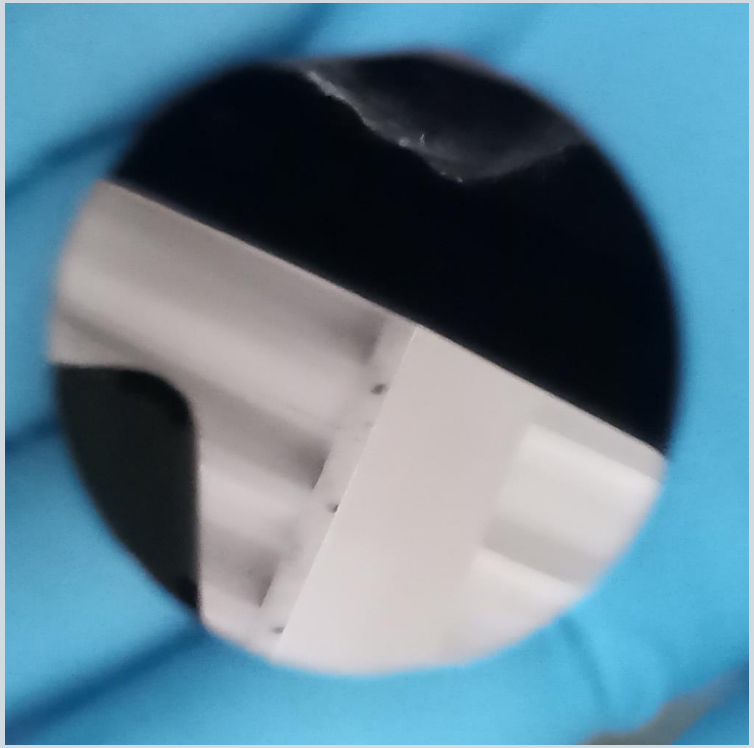
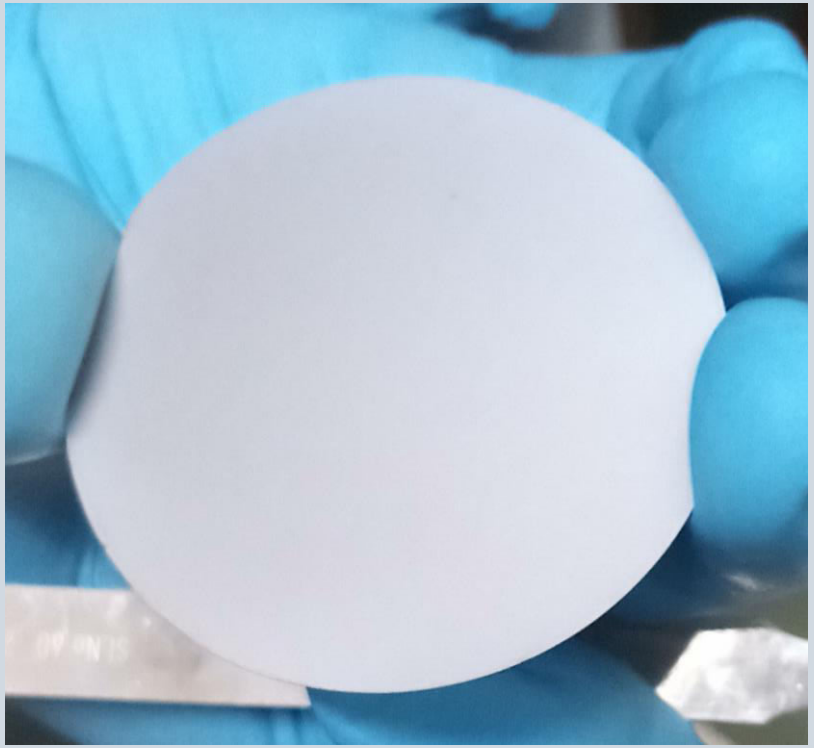
Initial Wafer



Polished Side
All steps are performed on this side

The wafer's base type can be either p-type or n-type
This is identified by:

- 2 flats on the wafer
  → n-type
- 1 flat on the wafer
  → p-type



Unpolished Side
The back contact is made on this side

Oxidation + Diffusion

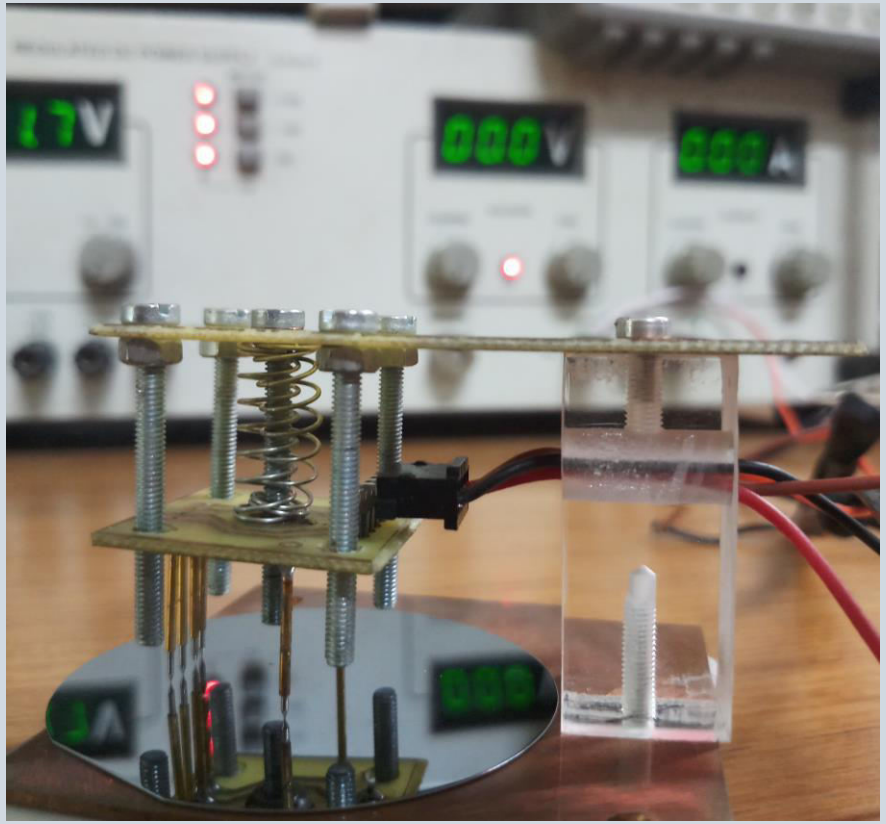
- The back side is oxidised
- Phosphorus diffusion (n-type) is performed on the front side
- A 500 nm n-type layer is formed

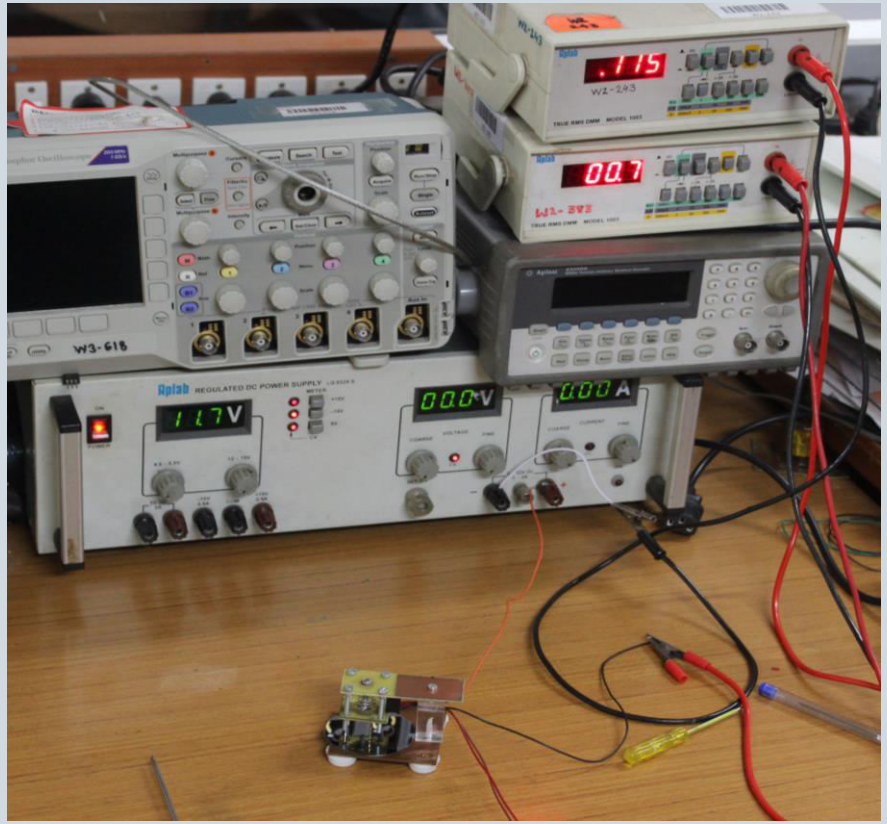
Four Probe Measurement

Four probe measurement is performed in order to measure the sheet resistance of the diffused wafer, hence verifying the process of diffusion

The expected sheet resistivity is 40 to 45 Ω cm^{-1}

Four Probe Measurement



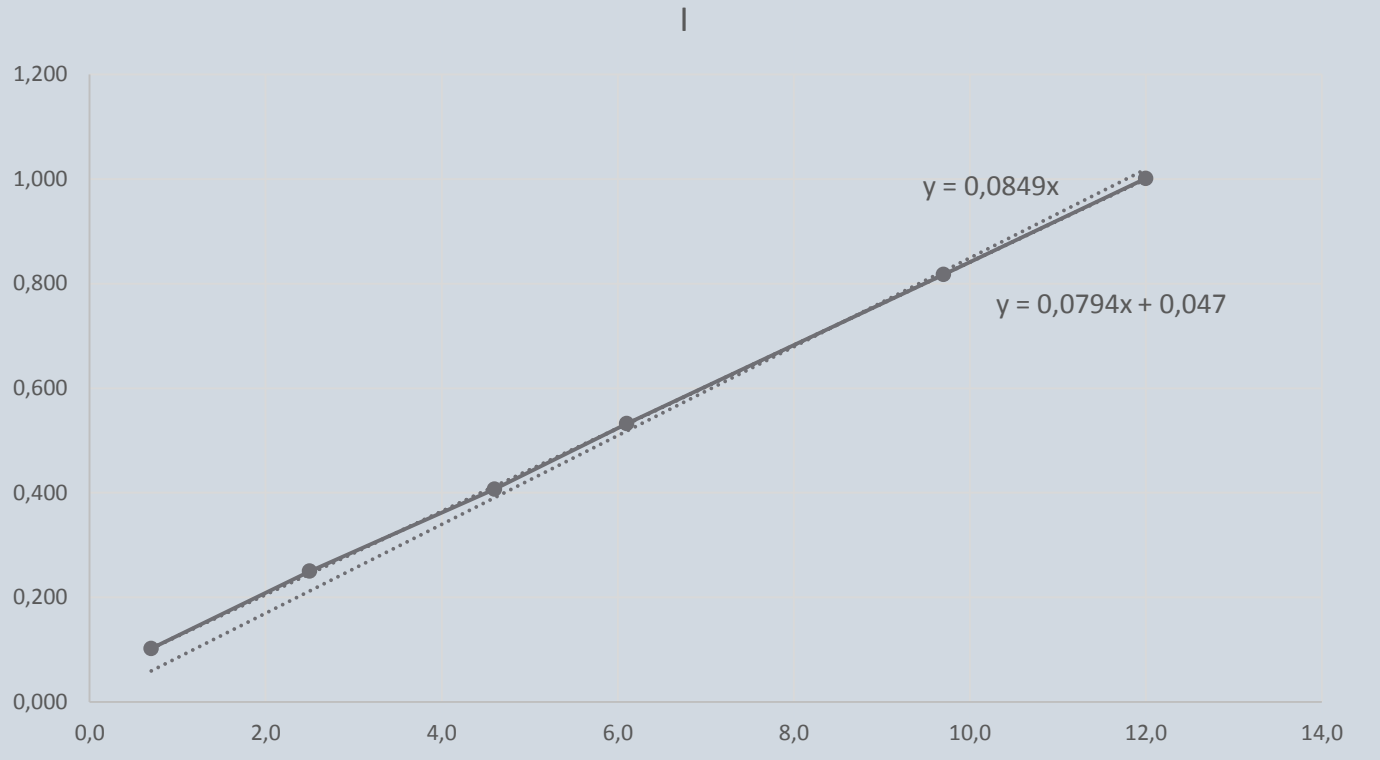


Made in WEL!!! ☺

Four Probe Measurement

$$R = \frac{\pi}{\ln(2)} \times \frac{V}{I} = 4.35 \frac{V}{I}$$

V	I	R
0.7 V	0.102 A	31.104 Ω
2.5 V	0.250 A	45.324 Ω
4.6 V	0.407 A	51.226 Ω
6.1 V	0.532 A	51.969 Ω
9.7 V	0.817 A	53.811 Ω
12.0 V	1.001 A	54.334 Ω



R (from the slope of the zero-intercepted tread line)	53.385 Ω

Lithography

- Used for making patterns on the wafer
- Used to create different features or multiple features of the same kind on the wafer
- Photo-lithography
  - Most popular form
  - Uses light to transfer a geometric pattern from a photomask to a light-sensitive chemical "photoresist" on the substrate
- The sample is prepared for lithography by dehydrating it on a hot plate for 10 min

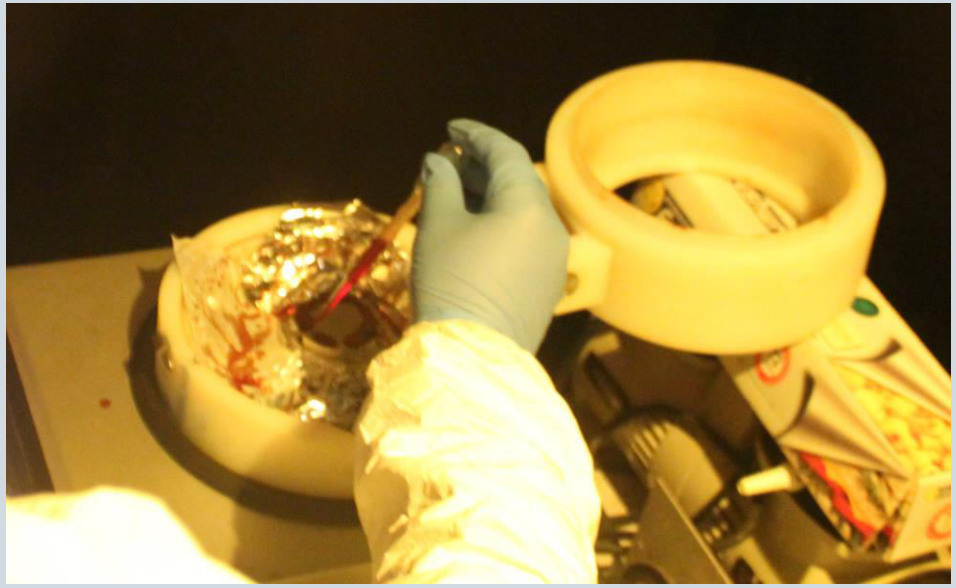
PPR Coating

Spin coat PPR at 3000 rpm for 30 sec followed by 1000 rpm for 10 sec

Pre-bake PPR for 5 min

PPR = Positive Photoresist

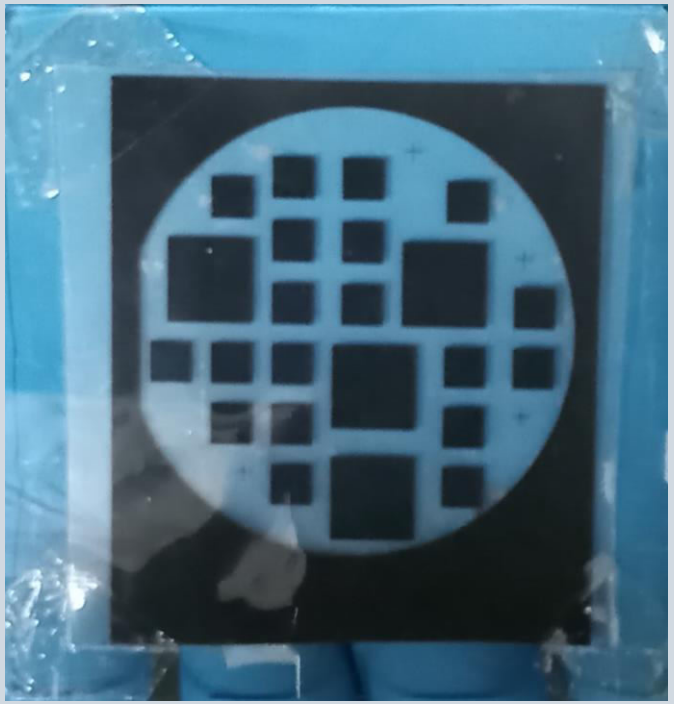
- The portion exposed to UV light turns jelly-like
- This portion is then removed using a developer solution

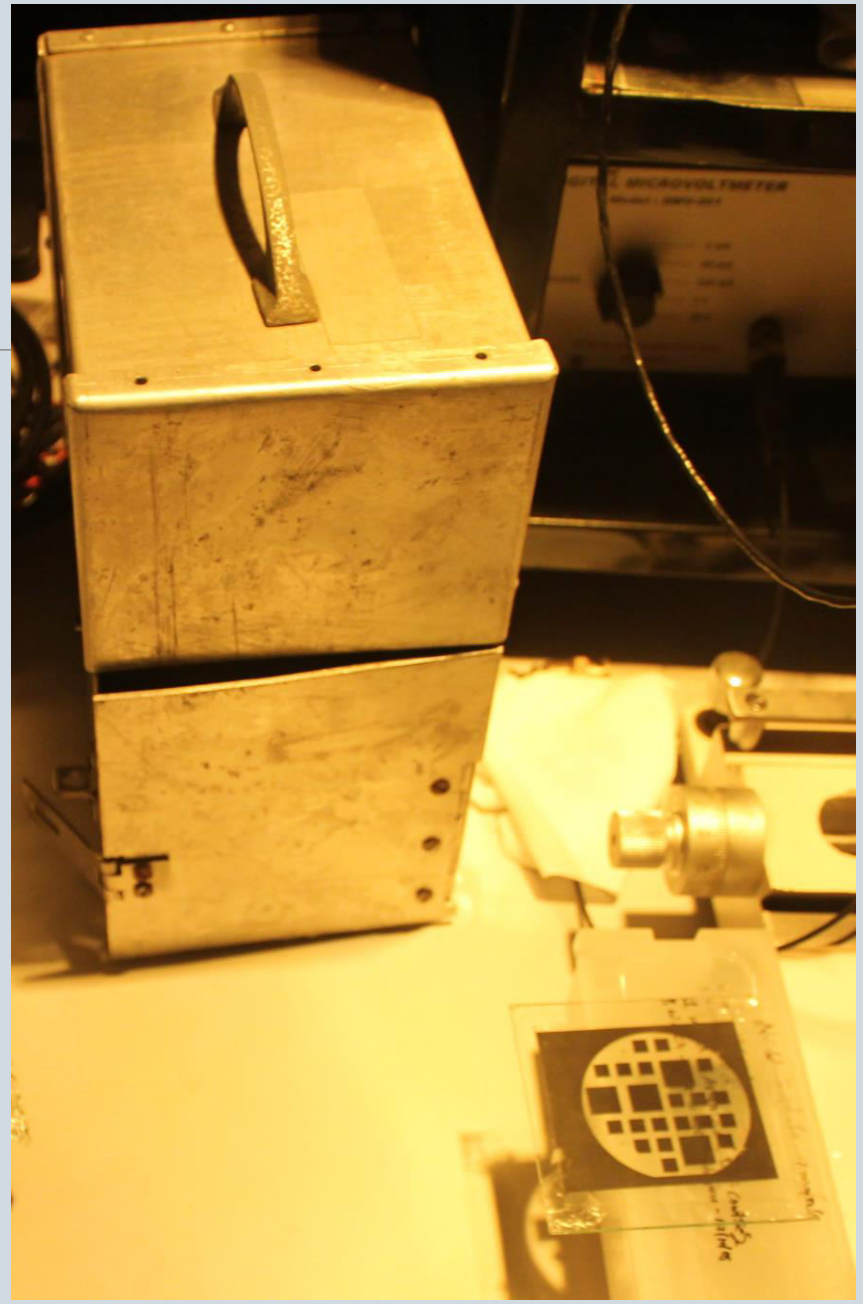


UV Processing

Place mask and pass UV light through the mask in the UV chamber for 2.5 min

Dip in developer solution



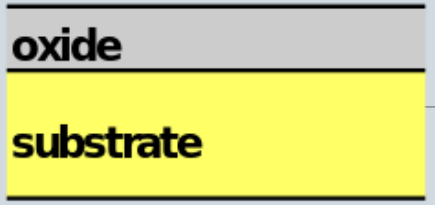


Oxide Etching and PPR Removal

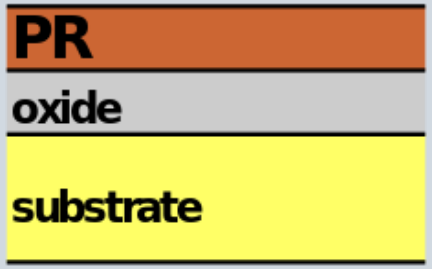
Dip in BHF (Buffered HF) to remove exposed oxide
Clean in deionised water
Dip in Acetone to remove PPR completely
Clean in Iso-Propyl Alcohol (IPA)

Summarising Lithography

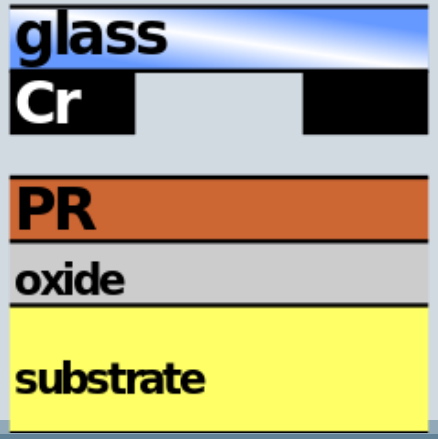
a. Prepare wafer



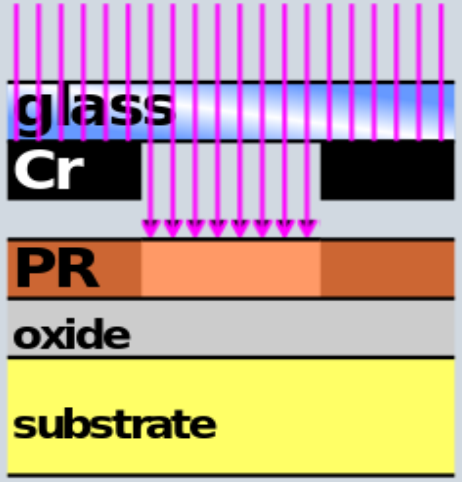
b. Apply photoresist



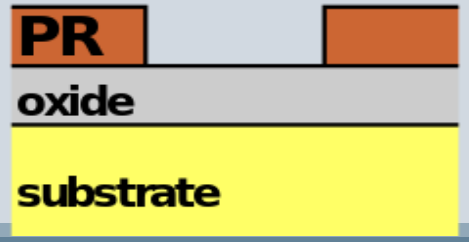
c. Align photomask



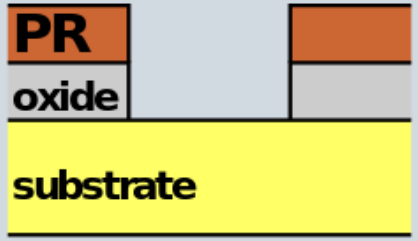
d. Expose to UV light



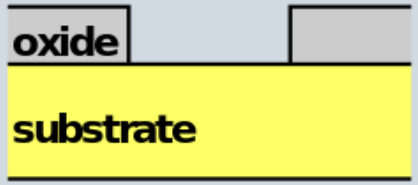
e. Develop and remove photoresist exposed to UV light



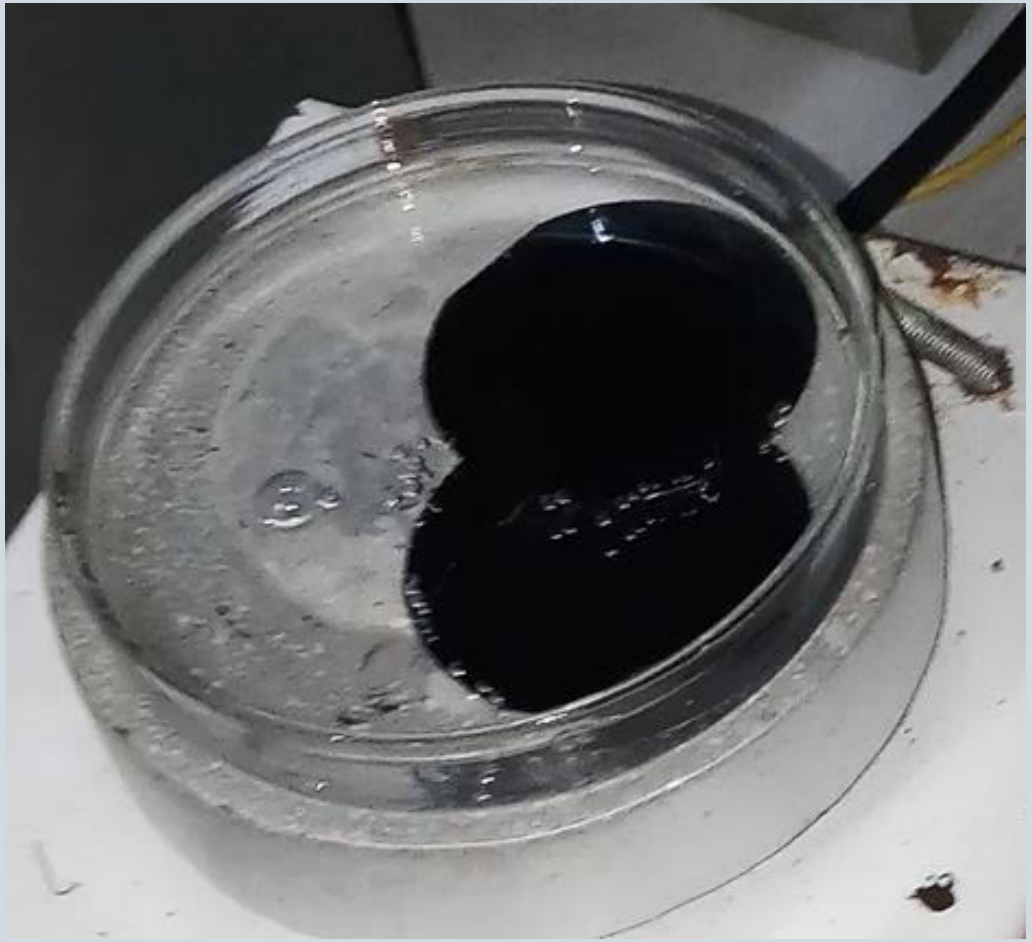
f. Etch exposed oxide



g. Remove remaining photoresist



TMAH Etching



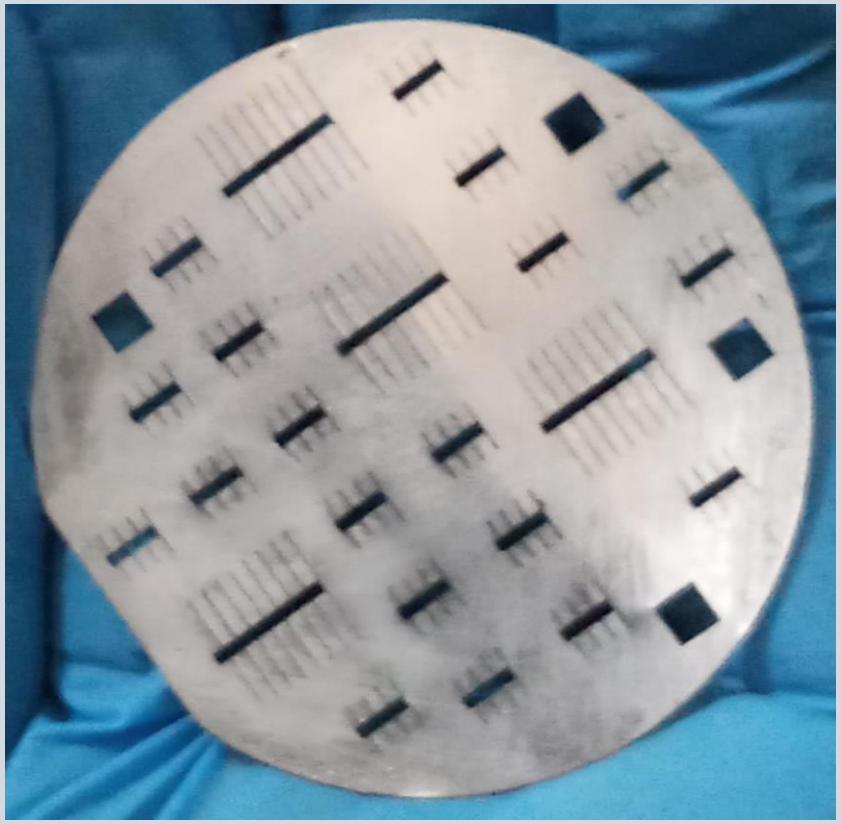
Tetramethylammonium hydroxide

- Dissolves Silicon
- Ignores Silicon dioxide

- Cuts through the n-type layer to separate different devices

- Etching speed = 0.2 µm min^{-1} at 95°C
- It is performed for 6 min

Making Contacts



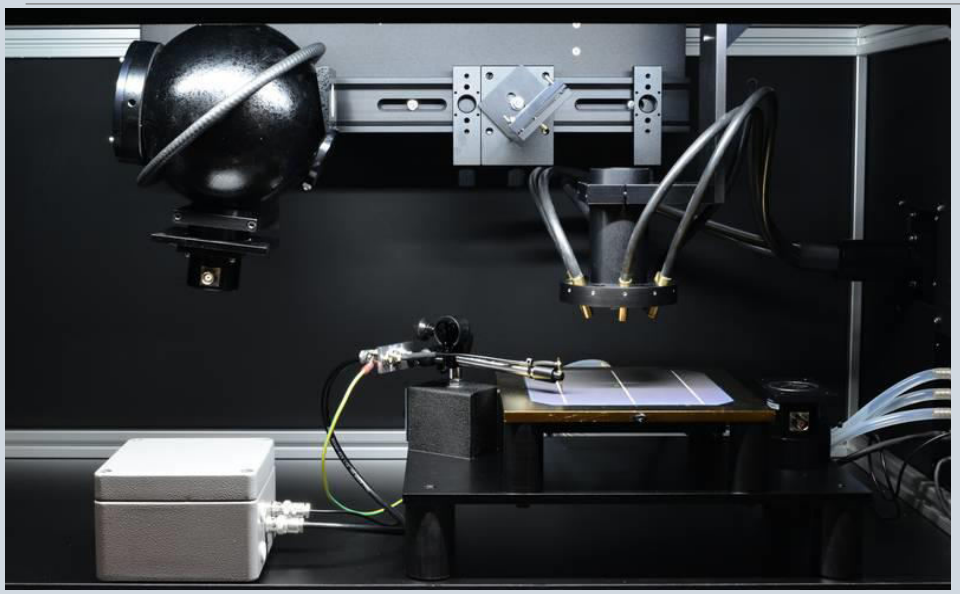
Back Contact

- Aluminium contact of 500 nm is made at the unpolished side and further silver for 100 nm
- Thermal annealing at 590°C for 5 min

Front Contact

- 50 nm Ti and 100 nm Ag is deposited through metal mask
- Thermal annealing at 285°C for 20 s

I-V Characterisation - Quantum Efficiency Measurement System




Q & A