

<b>Process flow title:</b>	<b>Pt100 Thin-Film RTD Process</b>	<b>Revision:</b>	<b>Rev 0.1</b>
Contact email:	jephin@dtu.dk	Contact name:	Jeppe Hinrichs
Contact phone:	Not applicable		
LabManager group:	Not applicable	Batch name:	TBD
Date of creation:	2025-09-29	Date of revision:	2025-10-03

---

## Process Overview

A process flow for fabricating a Pt100 resistance temperature detector (RTD) on oxidized silicon, using Ti/Pt thin films patterned by lift-off.

### Key Specifications

- Substrate: n-type silicon wafer, <100>, with thermal oxide isolation
- Insulating layer: 500 nm thermal SiO<sub>2</sub>
- Adhesion layer: 10 nm Ti
- Sensing layer: 100 nm Pt, patterned in meander geometry
- Nominal resistance: 100 Ω at 0 °C (Pt100)

### Critical Safety

- **HF handling:** Apron + gloves, face shield, no lone working, no glass beakers!
- **Solvents:** Acetone, IPA, resist remover: Use fume hood and PPE.
- **Sputter/evaporation:** Pt/Ti target change requires care; follow target handling SOP
- **Anneal:** Use thermal gloves for > 300 °C operations

## 1 Starting Material

Substrate	Specification	Thickness	Box Name	Qty
Silicon	n-type <100>, 4", 0.025 Ω cm	525 μm ± 20 μm	SN608	5

## 2 Critical Layers

Layer	Material	Thickness
Insulating oxide	Thermal SiO <sub>2</sub>	500 nm
Adhesion layer	Ti	10 nm
Resistive element	Pt	100 nm
Optional pad metallization	Ni/Au	20 nm Ni + 200 nm Au

## 3 Core Process Flow

Table 1: Pt100 RTD Process Flow

Step	Process	Equipment	Parameters	Comment
<b>1</b>	<b>Wafer Prep and Oxide</b>			
1.1	Incoming inspection	4-point probe + thickness tool	Measure resistivity, bow, thickness	Verify starting wafer specs.
1.2	Pre-oxidation clean	RCA bench	Standard RCA clean	Required prior to oxidation.
1.3	Thermal oxide growth	Furnace: E1 oxidation	Target: 500 nm Recipe: WET1100 Oxidation time: 50 min Anneal time: 20 min	Provides electrical isolation.
1.4	Inspection	Ellipsometer		Verify oxide thickness.
<b>2</b>	<b>Lithography</b>			
2.1	Resist coat	Spin Coater: Gamma UV	Recipe: 3421 DCH 100mm 5214E 2.2 μm HMDS Softbake: 100 °C, 60 s	
2.2	Pattern exposure	Maskless Aligner: MLA2	Mask: rtd_sulfiloger_wafer Dose: 50 mJ/cm <sup>2</sup> Wavelength: 375 nm	Expose regions that should remain after lift-off.
2.3	Image reversal bake	TMAH lithography	UV- Recipe: 2001 DCH PEB 110 °C 60 s	Crosslinks initially exposed resist (becomes insoluble).
2.4	Flood exposure	Aligner: MA6-2	No mask, blanket exposure Dose: 500 mJ/cm <sup>2</sup> Exposure time: 30 s at 11 mW/cm <sup>2</sup>	Reverses tone: unexposed areas become soluble.

Continued on next page

Table 1: Pt100 RTD Process Flow (Continued)

Step	Process	Equipment	Parameters	Comment	
2.5	Develop	TMAH lithography	UV- Recipe: 1002 DCH 100mm SP 60 s Developer: AZ 726 MIF single puddle, 60 s Rinse: DI water, 30 s	Creates undercut profile for lift-off.	
<b>3 Metal Deposition</b>					
3.1	Chamber prep	E-beam evaporator (Temescal)	Base pressure $\leq 1 \times 10^{-6}$ mbar	Lift-off friendly.	
3.2	Ti deposition	E-beam evaporator (Temescal)	10 nm Ti @ 0.5 Å/s to 1 Å/s	Adhesion layer.	
3.3	Pt deposition	E-beam evaporator (Temescal)	150 nm Pt @ 1 Å/s to 2 Å/s	Resistive layer.	
<b>4 Lift-off</b>					
4.1	Lift-off	Solvent bath (acetone)	Soak + ultrasonic assist if needed	Leaves Ti/Pt meander.	
4.2	Rinse/Dry	IPA + N2 gun		Inspect for clean edges, no flakes.	
<b>5 Post-processing (optional)</b>					
5.1	Optional anneal	C4 Furnace: N <sub>2</sub> ambient	400 °C, 1 h	Stabilizes Pt resistance.	
5.2	Optional pad metallization	Lithography evaporator	+ Ni/Au stack	Improves bondability.	
5.3	Final inspection	Optical microscope + probe	micro- 4-point	Measure sheet R, continuity	Target $R = 100\Omega$ at 0 °C.

## 4 Critical Checks

Step	QC Verification
1.3	Oxide thickness: 500 nm $\pm$ 10 nm (ellipsometer)
2.2	Lithography: line/space $\pm$ 1 µm (optical inspection)
3.3	Pt thickness: 100 nm $\pm$ 5 nm (Dektak XTA stylus profiler)
4.1	Lift-off complete, no bridging (microscope)
5.1	Sheet resistance stable within 1% after anneal (4-point probe)

## **5 Process Flow Diagram**

Figure 1: Process flow diagram for Pt100 RTD fabrication.

## 6 Required Figures

Table 2: Cross-sectional illustrations of key process steps in the Pt100 RTD fabrication flow.

ID	Step	Description
1	1.3	Thermal oxide isolation
2	2.2	Lithography defines meander
3	3.3	Ti/Pt deposition
4	4.1	Lift-off completed
5	5.1	Optional anneal / pad metallization