

Processes performed at the Thermal Processes Area

Techniques:

- Thermal silicon oxidation
- Diffusion and annealing processes
- Rapid thermal processing (RTP)
- Low pressure chemical vapor deposition (LPCVD)
- Plasma-enhanced chemical vapor deposition (PECVD)
- Atomic layer deposition, thermal (ALD) and plasma enhanced (PEALD)

Equipment:

Thermal silicon oxidation, diffusion and annealing processes and low-pressure chemical vapor deposition (LPCVD)

- Tempress, TS-Series V

4 racks of 4 horizontal tubular furnaces each. 15 furnaces are allowed to process CMOS (clean) samples, and 1 of them is focused on MNC processing (metal contaminated samples). Wafers up to 150 mm diameter.



Brand: **Tempress**, Model: **TS-Series V**
Furnace: **AFS**

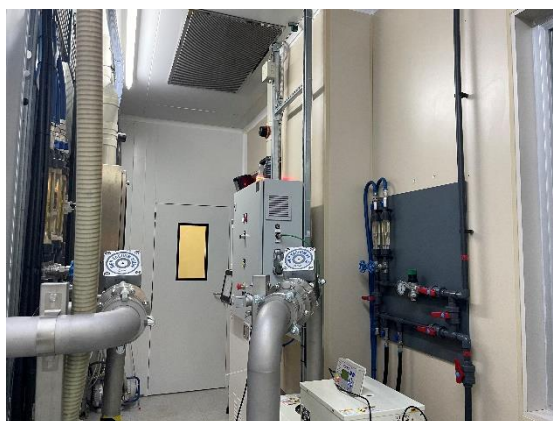


*Brand: **Tempress**, Model: **TS-Series V**
Furnace: **AFT***

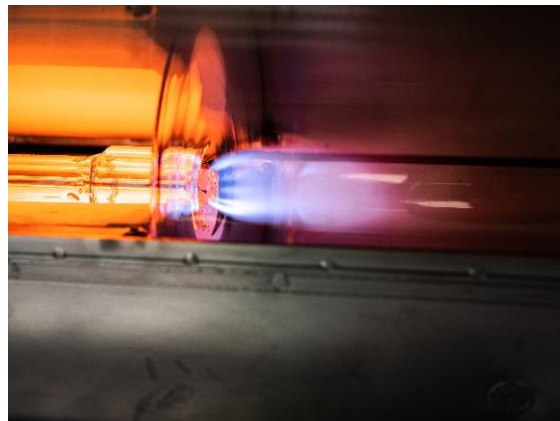
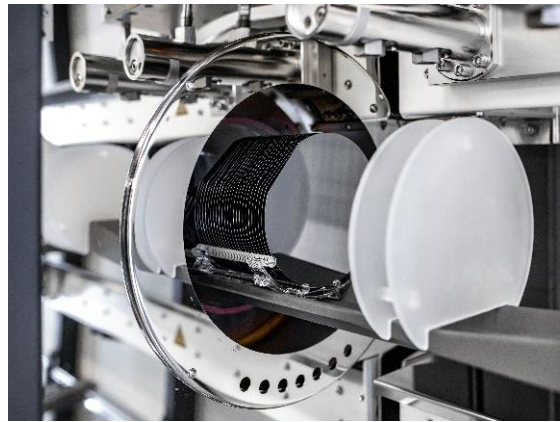




Brand: **Tempress**, Model: **TS-Series V**
Furnace: **AFU**



Brand: **Tempress**, Model: **TS-Series V**
Furnace: **AFK**



Brand: **Tempress**, Model: **TS-Series V**
Furnace Details

Rapid thermal processing (RTP)

- Annealsys, AS-Master-2000: 1 chamber. CMOS processing (clean samples). Wafers up to 200 mm diameter.

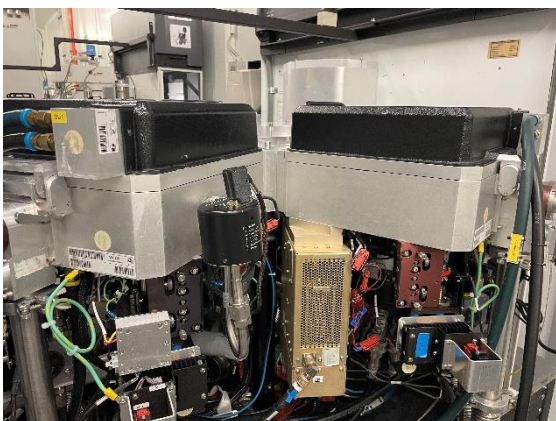
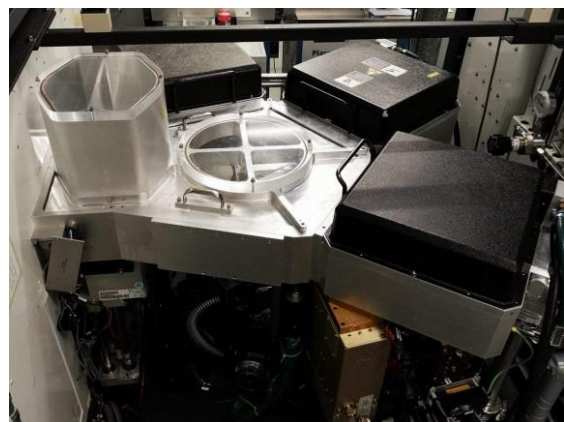




Brand: Annealsys, Model: AS-Master-2000

Plasma-enhanced chemical vapor deposition (PECVD)

- Applied Materials, Precision 5000 Mark II: 1 tool with 3 chambers. CMOS processing (clean samples). Wafers up to 150 mm diameter.
- Corial, D350L: 1 chamber. CMOS (clean samples). Wafers up to 150 mm diameter.
- Oxford IPT, Plasmalab 800 Plus: 1 chamber. MNC processing (metal contaminated samples). Wafers up to 200 mm diameter.

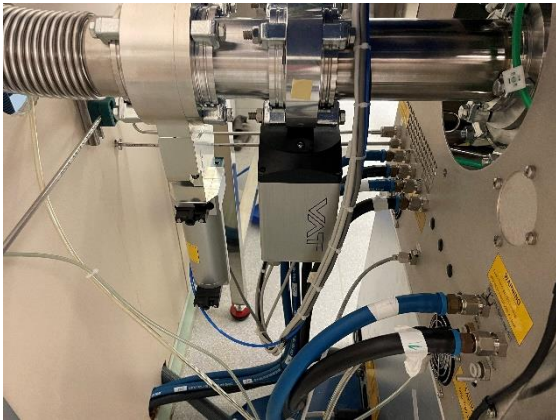


Brand: Applied Materials, Model: Precision 5000 Mark II



Brand: Corial, Model: D350L

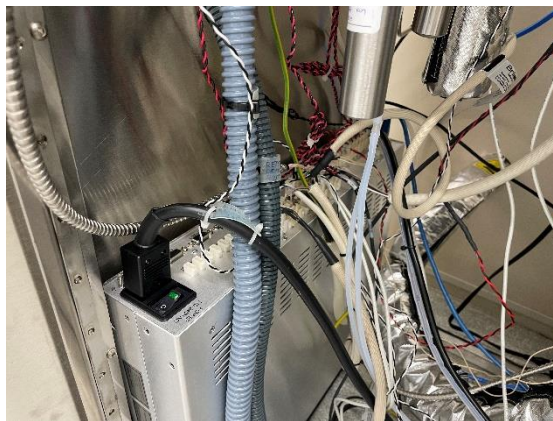
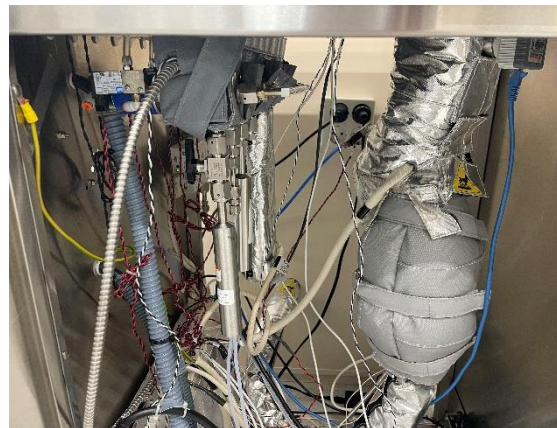
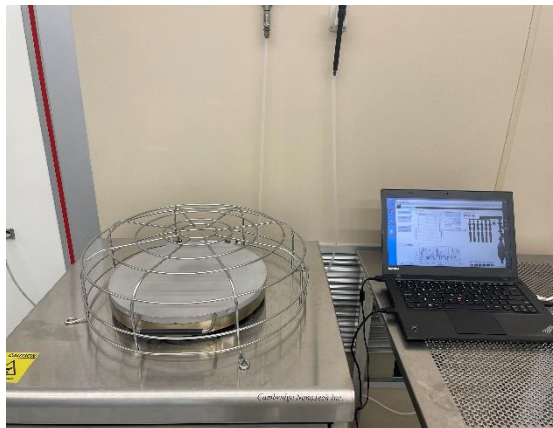




Brand: **Oxford IPT**, Model: **Plasmalab 800 Plus**

Atomic layer deposition (ALD, PEALD)

- Thermal: Cambridge Nanotech, Savannah 200: 1 chamber. CMOS processing (clean samples). Wafers up to 200 mm diameter.



Brand: **Cambridge Nanotech**, Model: **Savannah 200**

- Thermal and plasma enhanced: Picosun, R200 Advanced: 1 chamber. MNC processing (metal contaminated samples). Wafers up to 200 mm diameter.



Brand: Picosun, Model: R200 Advanced

Available capabilities:

Thermal silicon oxidation

- Temperature range from 900°C to 1100°C
- H₂ & O₂ or H₂O with C₂H₂Cl₂ environment
- Thickness range from 5 nm up to 3000 nm
- In-wafer and wafer to wafer uniformity below 1%
- Batch capacity 50 wafers

Diffusion and annealing processes

- Annealing in N₂, O₂, N₂O or Ar environment from 600°C to 1300°C
- Aluminum annealing in N₂/H₂ environment from 250°C to 450°C
- MNC thermal annealing from 600°C to 1100°C
- Phosphorus pre-deposition (Liquid source, POCl₃)
- Boron pre-deposition (Liquid source, BBr₃)
- Batch capacity 50 wafers

Rapid thermal processing (RTP)

- Rapid thermal annealing (RTA) available under O₂, N₂, N₂O and Ar environment from 400°C to 1200°C
- Rapid thermal oxidation (RTO) available under O₂ environment from 400°C to 1200°C
- Single wafer system

Low pressure chemical vapor deposition (LPCVD)

- Silicon nitride (Si₃N₄) deposition at 800°C for thicknesses from 10 nm to 500 nm
- Low stress silicon nitride (Si₃N₄) deposition at 850°C for thicknesses from 10 nm to 500 nm
- Polysilicon (PolySi) deposition at 630°C for thicknesses from 30 nm to 3 μm
- Amorphous silicon (a-Si) at 565°C for thicknesses from 30 nm to 3 μm
- Silicon oxide (SiO₂) at 700°C for thicknesses from 50 nm to 300 nm
- In-wafer and wafer to wafer uniformity below 3%
- High quality films and good step coverage
- Batch capacity 25 wafers

Plasma-enhanced chemical vapor deposition (PECVD)

Applied Materials – Precision 5000 mark II

- Automatic single wafer multi-chamber system with cassette
- Silicon oxide (SiO_2) deposition at 400°C for thicknesses from 50 nm to $5\ \mu\text{m}$
- Two silicon precursors available: Tetraethyl orthosilicate (TEOS) and Silane (SiH_4)
- Silicon nitride (Si_3N_4) deposition at 400°C for thicknesses from 50 nm to $1\ \mu\text{m}$
- Passivation layer: Silicon oxide (SiO_2) combined with Silicon nitride (Si_3N_4) at 375°C as diffusion barrier and against-moisture layer.
- In-wafer and wafer to wafer uniformity below 10%
- Batch capacity 15 wafers

Corial – D350L

- Silicon oxide (SiO_2) deposition up to 320°C for thicknesses from 50 nm to $5\ \mu\text{m}$
- Two silicon precursors available: Tetraethyl orthosilicate (TEOS) and Silane (SiH_4)
- Silicon nitride (Si_3N_4) deposition up to 320°C for thicknesses from 50 nm to $1\ \mu\text{m}$
- Amorphous silicon deposition (a-Si:H) at 200°C for thicknesses from 50 nm to 500 nm
- Deposition of doped silicon oxide (with Boron and/or Phosphorous) at 320°C to form BSG (borosilicate glass), PSG (phosphosilicate glass) or BPSG (borophosphosilicate glass) for planarization capabilities, and thicknesses between $1\ \mu\text{m}$ – $2\ \mu\text{m}$
- In-wafer and wafer to wafer uniformity below 10%
- Batch capacity of 7 wafers of 100 mm or 1 wafer of 150 mm

Oxford IPT - Plasmalab 800 Plus

- Silicon oxide (SiO_2) deposition (SiH_4) at temperatures up to 380°C for thicknesses from 50 nm to $5\ \mu\text{m}$
- Silicon nitride (Si_3N_4) deposition at temperatures up to 380°C for thicknesses from 50 nm to $1\ \mu\text{m}$
- Amorphous silicon (a-Si:H) deposition up to 300°C for thicknesses from 50 nm to $1\ \mu\text{m}$
- Dual frequency plasma available (13.56 MHz/350 kHz) for low stress silicon oxide and silicon nitride layers
- In-wafer and wafer to wafer uniformity between 10%
- Batch capacity of 8 wafers of 100 mm, 4 wafers of 150 mm or 1 wafer of 200 mm

Atomic layer deposition (ALD)

Cambridge Nanotech - Savannah 200

- Temperature range: from 150°C to 350°C
- Thicknesses from 0.5 nm to 50 nm
- Aluminum oxide (Al_2O_3)
- Hafnium oxide (HfO_2)
- Titanium oxide (TiO_2)
- Nanolaminates
- 2 types of oxidant precursors: D. I. H_2O and O_3
- In-wafer thickness uniformity around 1-2%
- Batch capacity of 2 wafers of 100 mm, 1 wafer of 150 mm or 1 wafer of 200 mm

Picosun - R200 Advanced

- Temperature range: from 60°C to 300°C
- Thicknesses from 0.5 nm to 50 nm
- Aluminum oxide (Al_2O_3), thermal and plasma enhanced
- Hafnium oxide (HfO_2), thermal and plasma enhanced
- Titanium oxide (TiO_2), thermal
- Silicon oxide (SiO_2), plasma enhanced
- Nanolaminates
- 2 types of oxidant precursors: D. I. H_2O and P. E. O_2
- In-wafer thickness uniformity around 1-2%
- Single wafer system

Staff

- Sara Durán (ext. 435561)
- Ricard Noy (ext. 435554)
- Elena Chica (ext. 435580)
- Olaf Vázquez (ext. 435688)