

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 (ALD)

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 is dedicated to MNC processing (metal contaminated samples). Wafers up to 150 mm diameter or below.



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**

Rapid thermal processing (RTP)

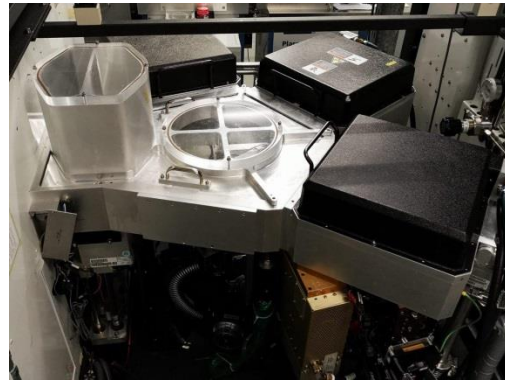
- Annealsys, AS-Master-2000: 1 chamber. CMOS processing (clean samples). Wafers up to 200 mm diameter or below.



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 or below.
- Corial, D350L: 1 chamber. CMOS (clean samples). Wafers up to 150 mm diameter or below.
- Oxford IPT, Plasmlab 800 Plus: 1 chamber. MNC processing (metal contaminated samples). Wafers up to 200 mm diameter or below.



Brand: Applied Materials, Model: Precision 5000 Mark II



Brand: Corial, Model: D350L



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

Atomic layer deposition (ALD)

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



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

Available capabilities:

Thermal silicon oxidation

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

Diffusion and annealing processes

- Temperature range: from 600°C to 1300°C.
- N₂, O₂, Ar, H₂O environment
- Batch capacity of 50 wafers
- Aluminum annealing in N₂/H₂ environment from 250°C to 450°C
- Phosphorus pre-deposition (Liquid source, POCl₃)
- Boron pre-deposition (Liquid source, BBr₃)
- MNC thermal annealing

Rapid thermal processing (RTP)

- Rapid thermal annealing (RTA) available under O₂, N₂ and Ar environment
- Rapid thermal oxidation (RTO) available under O₂ environment
- Batch capacity of 1 wafer

Low pressure chemical vapor deposition (LPCVD)

- Silicon nitride (Si_3N_4) deposition at 800°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 ($\alpha\text{-Si}$) at 565°C for thicknesses from 30 nm to 3 μm
- Silicon oxide (SiO_2) at 700°C for thicknesses from 30 nm to 1 μm
- Batch capacity of 25 wafers
- In-wafer and wafer to wafer uniformity below 3%
- High quality films and good step coverage

Plasma-enhanced chemical vapor deposition (PECVD)

Applied Materials – Precision 5000 mark II

- Automatic single wafer multi-chamber system with cassette
- Batch capacity of 15 wafers
- Silicon oxide deposition at 400°C for thicknesses from 10 nm to 5 μm
- Two types of silicon precursors available: TEOS (for high step coverage) and SiH_4
- Silicon nitride deposition at 400°C for thicknesses from 50 nm to 1 μm
- Passivation layer: Silicon oxide combined with Silicon nitride at 375°C as diffusion barrier and layer against moisture and water absorption
- In-wafer and wafer to wafer uniformity below 3-8%

Corial – D350L

- Batch capacity of 7 wafers of 100 mm or 1 wafer of 150 mm
- Silicon oxide deposition up to 320°C for thicknesses from 50 nm to 5 μm
- Two types of precursors available: TEOS (for high step coverage films) and SiH_4
- Silicon nitride deposition up to 400°C for thicknesses from 50 nm to 1 μm
- Amorphous silicon deposition ($\alpha\text{-Si:H}$) at 200°C for thicknesses from 50 nm to 1 μm
- 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) with planarization capabilities, and thicknesses between 1 μm – 2 μm
- Pressure range: 100 mT – 2 Torr
- In-wafer and wafer to wafer uniformity below 3%

Oxford IPT Plasmalab 800 Plus

- Batch capacity of 8 wafers of 100 mm, 4 wafers of 150 mm or 1 wafer of 200 mm
- Silicon oxide deposition (SiH_4 precursor) at temperatures up to 380°C for thicknesses from 50 nm to $5\ \mu\text{m}$
- Silicon nitride 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 deposition
- Pressure range: 100 mTorr – 2 Torr
- In-wafer and wafer to wafer uniformity between 3-6%

Atomic layer deposition (ALD)

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