

Micro and Nanofabrication Clean Room

Techniques and equipment

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



ASM, LB45: 2 racks of 4 horizontal tubular furnaces, CMOS (clean samples), Wafers up to 100 mm diameter or below.



BTU, Bruce: 1 rack of 2 horizontal tubular furnaces, CMOS (clean samples) or MNC (metal contaminated samples), Wafers up to 150 mm diameter or below.

Diffusion and annealing processes: *The same ones as in the oxidation module.

Rapid thermal processing (RTP)



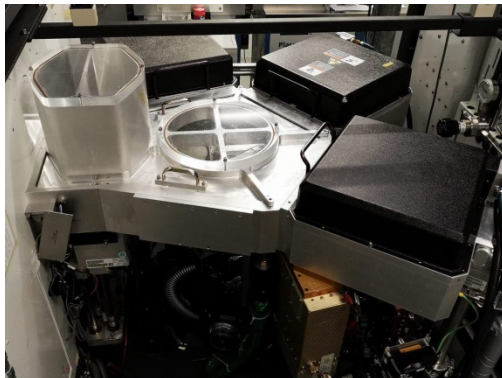
Annealsys, AS-Master-2000: 1 chamber, CMOS (clean samples), Wafers up to 200 mm diameter or below.

Low pressure chemical vapor deposition (LPCVD)



ASM Semy Engineering, ETNA HT-210: 1 rack of 2 horizontal tubular furnaces, CMOS (clean samples), Wafers up to 100 mm diameter or below.

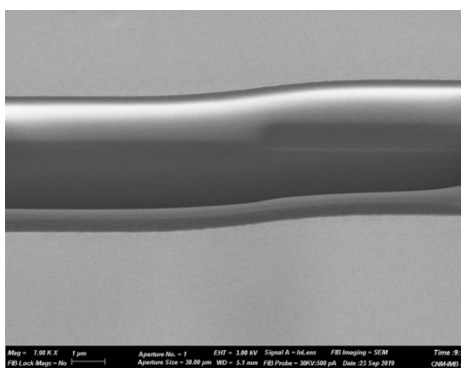
Plasma-enhanced chemical vapor deposition (PECVD)



Applied Materials, Precision 5000 Mark II: 1 tool with 3 chambers, CMOS (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.



Example of planarized BPSG



Oxford IPT, Plasmalab 800 Plus: 1 chamber, MNC (contaminated samples), Wafers up to 200 mm diameter or below.

Atomic layer deposition (ALD)



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

Available capabilities:

Thermal silicon oxidation

- Temperature range: from 950°C to 1150°C
- Thickness range from 5 nm up to 2500 nm
- Batch capacity of 50 wafers
- In-wafer and wafer to wafer uniformity below 1%
- O₂, H₂O and chlorine environment

- Diffusion and annealing processes
- Temperature range: from 600°C to 1150°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 (Solid source, BN/B₂O₃)
- Thermal annealing of Polyimide and several metals

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 at rapid thermal tool 1 wafer

Low pressure chemical vapor deposition (LPCVD)

- Silicon nitride (Si₃N₄) deposition at 800°C for thicknesses from 10 nm to 500 nm
- Undoped Polysilicon deposition at 630°C for thicknesses from 30 nm to 5 µm
- Undoped Amorphous silicon (α-Si) at 570°C for thicknesses from 30 nm to 1 µm
- Batch capacity of 15 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 SiH₄
- 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 SiH₄
- Silicon nitride deposition up to 400°C for thicknesses from 50 nm to 1 µm
- Amorphous silicon deposition (a-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 $5\text{ }\mu\text{m}$
- Silicon nitride deposition at temperatures up to 380°C for thicknesses from 50 nm to $1\text{ }\mu\text{m}$
- Amorphous silicon (a-Si:H) deposition up to 300°C for thicknesses from 50 nm to $1\text{ }\mu\text{m}$.
- 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/Alumina (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: H_2O d.i. and O_3
- In-wafer thickness uniformity around 1-2%