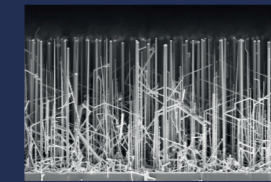




Conformal deposition in a trench



Ge nanowires grown on Si

FURNACES

- 12 furnace tubes for dedicated processes
- Max temp 1100°C
- Sample Size (small pieces to 4" full wafers)
- Batch processing (25 wafers at a time)
- SiO₂, Poly-Si, Si₃N₄, SiGe, Doping and Diffusion



- Rapid Thermal Processing systems
- Up to 1200°C, ramp rates 30° - 200°C/sec
- N₂, H₂, N₂O, NH₃ and O₂ gas lines
- Contact alloying, Oxidation and Nitridation
- Silicidation



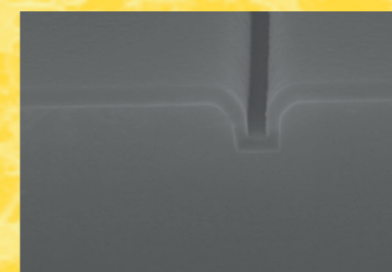
RF & DC SPUTTER TOOLS

- Dedicated tools for metals and dielectrics
- More than 50 materials to sputter
- Multi-target and multi-wafer holders with planetary system
- 50° - 600°C substrate temperature range

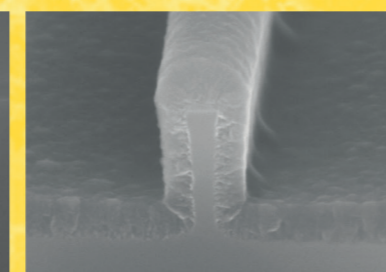
CVD AND THIN FILMS

PECVD

- 6" wafers to small pieces
- Substrate temperature up to 400°C
- Gases - H₂, SiH₄, GeH₄, CH₄, NH₃, CF₄, N₂O, N₂, Ar, 2% B₂H₆/Ar, 1% PH₃/Ar
- Materials: a-Si, SiO₂, Si₃N₄, SiC and SiGe



Conformal trench coverage



Conformal step coverage



ATOMIC LAYER DEPOSITION

- Up to 8" wafer
- Substrate temperature range: 25° - 400°C
- Materials: Al₂O₃, TiO₂ and ZnO



E-BEAM EVAPORATION

- Dual e-gun and dual-hearth system
- Multi wafer holders (four) with planetary system
- Substrate temp up to 300°C
- Max 6" wafers to small pieces
- Co-evaporation and ion-assisted deposition possible
- 46 materials
- Ion-etching for pre-cleaning substrate



IN-LINE CHARACTERIZATION



- Ellipsometer
- 12" wafer capability
- Standard models for many materials
- Surface profiler
- Step height and 3D mapping
- Curvature profiler
- Contactless Hall mobility
- Four-point probe

WHAT WE OFFER

- Basic and advanced training in process technologies
- Access to a large range of process equipment in our cleanroom
- Consultancy and services ranging from unit or integrated process steps all the way up to prototyping a device



NATIONAL NANO FABRICATION CENTRE

CONTACT US

NATIONAL NANO FABRICATION CENTRE
CENTRE FOR NANO SCIENCE AND
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OVERVIEW

National Nano Fabrication Centre (NNFC) is a national facility open to public and private academic institutes, private industries, public sector undertaking and Indian strategic sector.

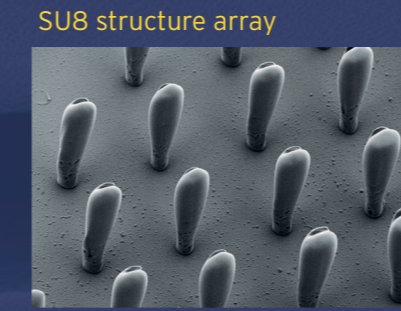
NNFC is a class 100 and class 1000 state-of-the-art fabrication facility spanning over an area of 14,000 sq ft, enabling More-Moore and More-than-Moore technologies including MEMS/NEMS, photonics, PV, spintronics, sensors, actuators and materials development.

Supported by 24/7 cleanroom utility and dedicated staff members, NNFC is capable of realizing micro and nanoscale devices on various substrates that include Si, GaN, SiC, Quartz, Glass, Graphene and III-V semiconductors.



DIRECT WRITING AND MASK MAKING

- Minimum features down to 1 μm
- Alignment accuracy - 200nm
- Sample/mask size: 6" wafer/mask down to small pieces
- Design file format - GDS2/CIF/DXF



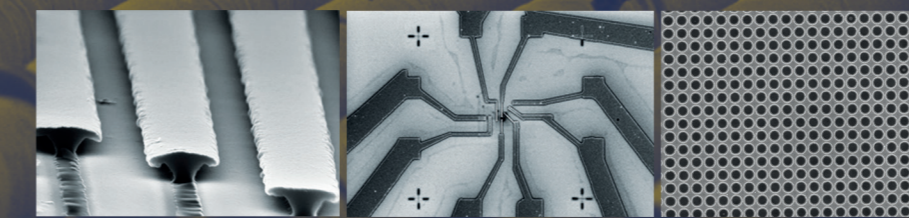
1 micron gap between large structures



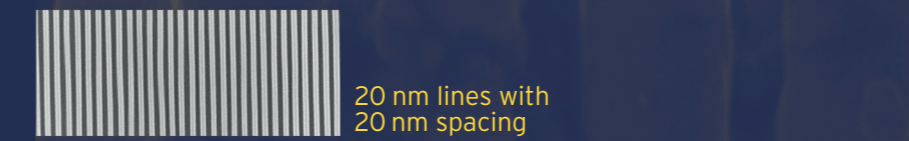
LITHOGRAPHY

E-BEAM LITHOGRAPHY

- Accelerating voltage: 30 kV
- Apertures: 7.5, 10, 20, 30, 60, 120 μm
- Minimum feature size: Sub-10 nm
- SEM feature
- Spot size with 30 μm aperture
@ 1 kV: 4 nm
@ 20 kV: 2.1 nm



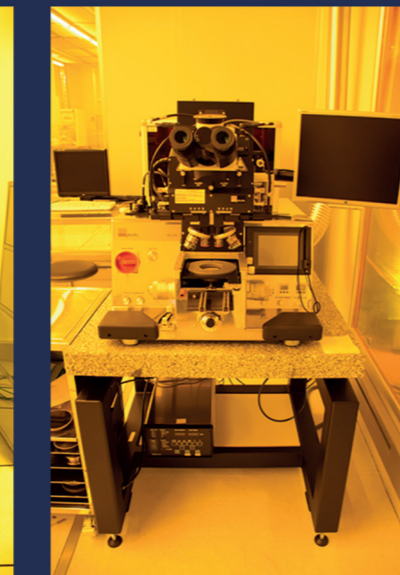
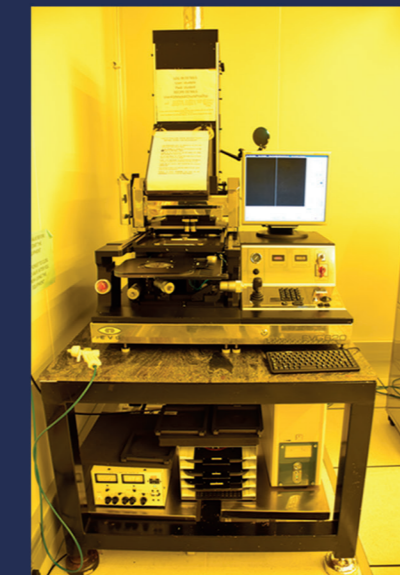
Bi-layer for lift-off process Contact pads for nanowires 50 nm structures



20 nm lines with 20 nm spacing

WAFER BONDER

- Up to 4" substrate and quarter wafer pieces can be handled
- Types of bonding available:
Eutectic bonding (Si-Au-Si)
Anodic bonding (Si-Glass)
Fusion bonding (Si-Si)



OPTICAL LITHOGRAPHY

- Minimum features down to 1 μm
- Alignment accuracy
1 μm front side
5 μm back side
- Sample size - 6" wafers down to small pieces
- Design file format - GDS2/CIF/DXF



1-micron lines 2-micron squares Bi-layer lift-off process

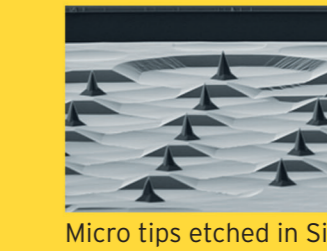
Housed in Class 100 area in the cleanroom, the lithography bay has several tools with minimum feature size patterning capability ranging from a few microns all the way down to a few nanometers.



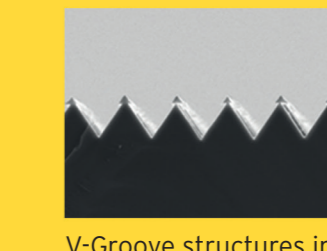
Dedicated wet benches to avoid cross-contamination

In NNFC cleanroom, dedicated wet processing stations are available for wafer cleaning and etching various materials.

WET ETCH



Micro tips etched in Si



V-Groove structures in Si



Critical Point Drier (CPD)

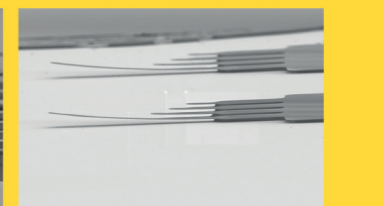


HF vapour etch

Critical point drying and vapour-phase HF etching render stiction-free released structures.



Released RF MEMS switch



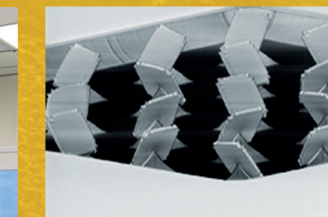
Released cantilevers

A special Deep Reactive Ion Etch (DRIE) equipment is used for through-Si wafer etching for MEMS applications.

DRY ETCH



RIE tools



Micro mirrors



Nano pillars etched in Si

- Dedicated FI and CI based chemistry
- Si, III-V, dielectric and metal etching
- Isotropic and anisotropic
- Input gases - O_2 , Ar, C_4F_8 , N_2 , H_2 , Cl_2 , BCl_3 , CH_4 , HBr , SF_6 , CHF_3
- 6" wafers to small pieces



DRIE tool



Floating rings etched in Si

- Dedicated to Si deep etch
- Through Si wafer via etch can be done
- Maximum Si etch rate ~ 30 $\mu\text{m}/\text{min}$
- Up to 50 aspect ratio in etch
- 6" wafers to small pieces