FACT SHEET

CLEANROOM

Binnig and Rohrer Nanotechnology Center

WHY A CLEANROOM?

The cleanroom is intended for exploratory research on new materials and new devices with dimensions down to the nanometer scale. The fabrication of small structures on the nanometer scale requires a very low particle count during the whole fabrication process to make sure that a reasonable yield of functional devices is achieved after all processing steps are completed.

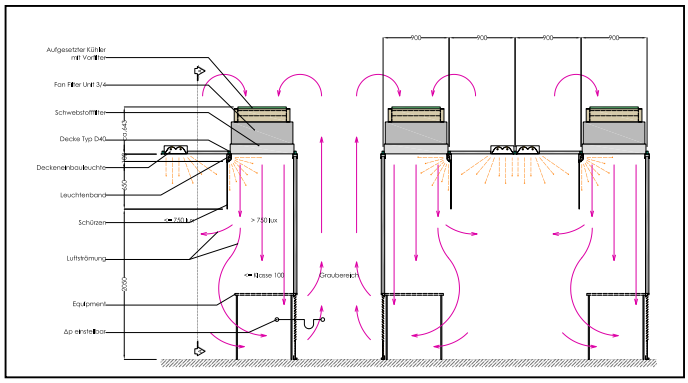

Diagram showing the airflow and filter systems in the cleanroom

Wafer processing in the lithography section of the cleanroom

CLEANROOM STRUCTURE AND CONDITIONS

The cleanroom is designed in a **bay-chase layout**, where individual cleanroom bays are surrounded by a service area. The wafer processing and handling takes place inside the cleanroom bays, while the service area or grey room houses auxiliary equipment and is used to connect the tools to all necessary media (electricity, water, gases, ventilation, etc.).

The **quality** of a cleanroom is measured by its cleanroom class and ranges from class 100 (ISO 5) to class 10 000 (ISO 7) for the individual sectors.

A cleanroom class of 100 means that a maximum of 100 particles bigger than 0.5 micron size is allowed in a volume of 1 cubic foot air. This particle count is typically 4 to 5 orders of magnitude lower than in the normal environment. The low particle count in a cleanroom is achieved by the use of particle filters and a suitable air flow.

Temperature and relative humidity in the cleanroom have to be controlled to 20° - 22° C and 45 %, respectively, to ensure process stability, for example for the processing of photo resists.

At a glance

- Total size: 950 m^2
- Cleanroom classification: Class 100 (ISO 5) to Class 10 000 (ISO 7)
- Maximum air intake: 40 000 m^3/h
- Temperature control: 20°-22°C (+/- 1°C)
- Humidity control: 45 % (+/- 5 %)

PROCESS SECTORS AND EQUIPMENT

The cleanroom is not a production or pilot line with fixed processes or fixed wafer size; flexibility is of utmost importance.

Processes, most of which will be semiconductor-based will be conducted on materials similar to those used in standard semiconductor technology, such as silicon, germanium, III-V semiconductors, carbon, graphene, metals, insulators, polymers, organics and oxides. Small pieces up to 6 inch wafers can be processed, for some tools wafers up to 200 mm size will be possible.

The cleanroom consists of different sectors with a broad set of processing tools. The following list shows the most important tools and methods:

Optical lithography sector for substrate preparation and definition of resist patterns

- Mask Aligner for optical contact printing
- Direct Laser Writer
- Resist Coaters, Hotplates, Developer, Ovens

Wet processing sector for wet chemical etching and surface modification

- Wet benches with various chemicals
- HF vapor phase etcher

Thin film deposition sector for the deposition of various material

- Evaporation
- Sputtering
- Atomic Layer Deposition (ALD)
- Plasma Enhanced Chemical Vapor Deposition (PECVD)

Dry etching sector for pattern transfer and material removal using (reactive) gases

- Reactive Ion Etching (fluorine-based chemistry)
- ICP etching (chlorine-based chemistry: Cl_2, HBr)
- Ion Beam Etching
- Silicon Deep Trench Etching using the “Bosch-Process”

Thermal processing sector for oxidation, annealing, and vapor phase deposition

- Oxidation furnace (dry and wet oxidation of Si)
- Rapid Thermal Annealer (RTA)
- Low Pressure Chemical Vapor Deposition (LPCVD)

Metrology / Inspection sector for process characterization and control

- Optical microscopes
- Scanning electron microscope (SEM)
- Focus Ion Beam (FIB) tool
- Ellipsometer
- Atomic Force Microscope (AFM)

Back-end sector for plating, lapping/polishing, dicing, and bonding

- Lapping / Polishing tool
- Chemical Mechanical Polishing (CMP)
- Wafer Dicer
- Electroplating setups
- Bonders (wire bonder, die bonder, wafer bonder)

Carbon Deposition sector for deposition of carbon nanotubes (CNT) and grapheme films

- PECVD for CNT growth
- Graphene growth tool

IBM sector

- Polymer waveguide processing for optical interconnects

ETH sector

- Tools and processes not defined yet

CLEANROOM MEDIA

Water supply system

- Process cooling water (closed loop) for process equipment
- Ultrapure water supply for wafer processing (18.2 MOhm*cm)
- Standard tap water

Compressed dry air

Gas supply system for 27 different process gases

- Standard gases (N_2, Ar, He, O_2)
- Speciality gases

Safety installations

- Fire/smoke detection
- Double-wall tubings for critical gases
- Monitoring system for gas detection