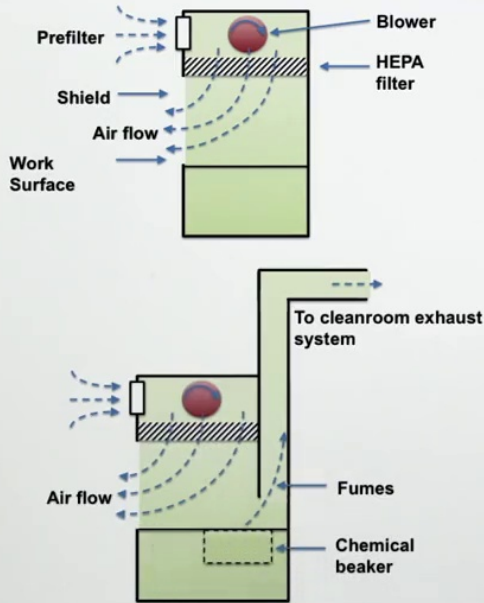


Cleanroom work station strategy

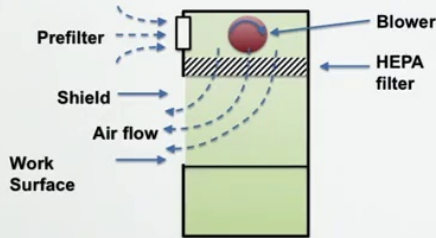


- Processing of wafers in individual work stations with filtered air
- Work stations (hoods) are arranged in rows and are provided with high-efficiency particulate arrestance (HEPA) filters, containing small holes and a large surface
- Vertical laminar flow (VLF) and horizontal laminar flow hoods are used

Micro and Nanofabrication (MEMS)

How does one obtain clean air with a minimum number of particles? The first possibility is to do the processing of the wafers in individual work stations with filtered air. These work stations or hoods are arranged in rows and are provided with high efficiency particulate arrest, or HEPA filters, which contain small holes and a large surface. Air is blown through such a filter and a vertical laminar flow exposes the wafers that are manipulated here in the hood. So the wafers are only exposed to highly purified air with a minimum number of particles. If chemicals are operated in the hood, this is not the right construction, as the toxic fumes of the chemical would go to the operator. If one needs to manipulate chemicals, the hood is of this type. Part of the laminar flow is evacuated via this line so that there is no risk for the operator who is working here to be in contact with these chemical vapors because basically, he is doing his manipulation here in this area.

Cleanroom work station strategy

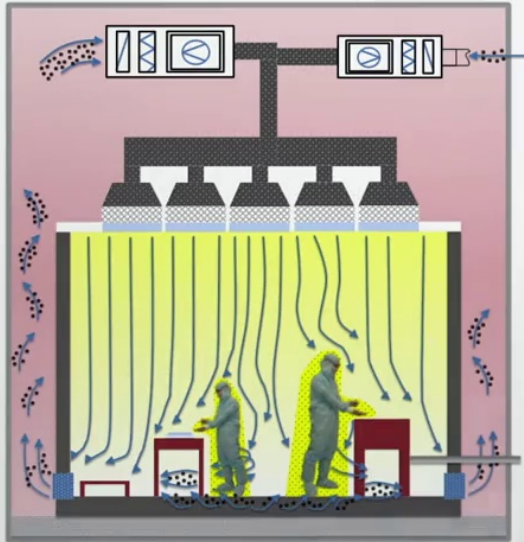


- Processing wafers in individual work stations with filtered air
- Work stations (hoods) are arranged in rows and are provided with high-efficiency particulate attenuation (HEPA) filters, containing small holes and a large surface
- Vertical laminar flow (VLF) and horizontal laminar flow hoods are used
- Drawback of laminar flow hood: vulnerability to contamination from people in the room → better build HEPA filters in ceiling of the room and provide clean conditions everywhere; this is more expensive

Micro and Nanofabrication (MEMS)

The picture on the left shows a hood for the manipulation of chemicals. A drawback of such laminar flow hood is that the environmental conditions can change due to the people that are present in the room and who can be the origin of particles underneath the hood. Therefore, a better but also a more costly solution, is to build these HEPA filters in the ceiling of the room and provide everywhere in the room clean conditions. That is what makes a really clean room.

Total cleanroom strategy



- Continuous laminar flow from the ceiling to the floor, also through tabletops with perforations, etc.
- Tight control of
 - Temperature (operator comfort and process control)
 - Humidity (e.g. moisture on wafers prevent adherence of photoresists)
 - Smog (e.g. ozone interferes with photoresist development processes)



Micro and Nanofabrication (MEMS)

This brings us to concept of the total clean room where the complete clean room has purified air due to the presence of a continuous laminar flow from the ceiling to the floor. Also, through table tops with perforations, and so on. Purified air will expose the wafers and the people, and any generated particles will be transported away through the floor and be purified before being re-injected through HEPA filters in the clean room. The clean room not only has good purity of the air, but there is also a tight control of the temperature which is essential for operator comfort and for reproducibility of chemical processes. Also the humidity has to be controlled as the presence of moisture on wafers can influence many processes like the adhesion of a photoresist for example. Also, smoke needs to be avoided. As a reactive gas, it is like ozone, it can interfere with many chemical processes that are running in the clean room. These two photographs show part of the air-handling infrastructure of a clean room that is present above and below the clean room area.

Summary



- Cleanroom is necessary for microfabrication of miniaturized devices
- Air, process chemicals, water, and gases should be of high purity
- Two approaches: laminar flow hood for local clean air conditions and 'total cleanroom'
- Center of MicroNanotechnology at EPFL (CMI)

Micro and Nanofabrication (MEMS)

A high quality clean room is essential for high quality research in microfabrication related areas. At EPFL, we have such a clean room which really is a corner stone of many of our research and educational activities. The following video provides a glimpse of the EPFL center of micro and nano technology. In this lesson I explained that the clean room is a necessary infrastructure for the reproducible microfabrication of miniaturized devices. Air, process chemicals, water and gases should all be of high purity. We have discussed two approaches of creating a clean room environment. First there was the laminar flow hood for creating locally clean air conditions and next, there was a total clean room strategy. Finally, I introduce to you the center of micro and nano technology at EPFL.
