General Utilities in MicroFab:

1. Switch on the vacuum pump. It is located outside the clean room in the far corner (see Fig. 1).
2. Switch on the de-ionized water equipment. It is located outside the clean room (see Fig. 1).
3. Turn on the de-ionized water input.
4. Remove the de-ionized water from the tanks in the etching streets. The life time of de-ionized water in those tanks is less than 2 days.

SC1 clean:

- Take 800 ml of de-ionized water
- Take 64 ml of Hydrogen Peroxide (30%) (Blue cabinet)
- Take 16 ml of Ammonium Hydroxide (10-35%) (Blue cabinet)
- Switch on heating plate in the chemical bench A.
- Turn the heater dial to maximum until the temperature reads 70-80 ^{o}C.
- Turn the heater dial to 5.5.
- Put the white wafer holder in SC1 beaker to clean it.
- Slide the wafer (flat side) on the wafer holder
- Keep the wafer in SC1 bath for 10 minutes
- Remove the wafer from the SC1 batch and rinse with de-ionized water for 3 minutes (both sides of the wafer). Use the DI-tube at the faucet since the tanks in the etching benches are not large enough to facilitate such a long rinse.
- Spin the wafer dry in etching bench 1 (B). Place the wafer back in a wafer box.

The lifetime of SC1 potion is about 2 hours or 6 to 7 wafers covered with photoresist. After this time all peroxide will have been used to oxidize the organic materials or has been evaporated from the cocktail.

Furnace operation:

- Turn on main switch and Power switch (SW1) at the same time.
- To adjust the temperature, adjust the center zone; the other two zones will automatically follow. Turn the center zone temperature up to 1000 ^{o}C.
- For wet oxidations, put water in the glass container, and switch on the water heater.
- If the furnace is at 700 ^{o}C, open the N_2 and O_2 cylinders in the service corridor. The N_2 pressure should read 60 psi and the O_2 pressure should read 20 psi.
- Open the N_2 flow valve to flush the furnace and remove all oxygen.

- For spin on doping diffusions calculate the recommended flow rates. Use the table to determine the settings of the flow-valves. For n-type diffusion O_2:N_2 is 1:4. For this setting use flow rate 5 for O_2 and flow rate 20 for N_2.
- Place the wafer in the wafer boat
- Put on your gloves
- Remove the furnace cap
- Attach the cradle tray to the furnace entrance.
- Slide the wafer boat in the furnace
- Remove the cradle tray
- Shift the wafer boat all the way in the tube furnace (all the way is the length of the stick minus 6").
- Place the cap back on the furnace
- Increase the temperature to 1000 ^{o}C.
- Open the oxygen at 1000 ^{o}C (for above mentioned process: flow rate 5).
- After 45 minutes turn off the O_2 and put the temperature controller back to zero.
- When the temperature drops below 1000 ^{o}C turn off the N_2 and remove the wafer.

Diffusion:

- Diffusion in a (100) wafer is faster than in a (111) wafer.
- Boron diffusion: 50 minutes at 1100 ^{o}C will result in a 2-2.5 μm diffusion well.
- Phosphor diffusion: 15 minutes at 1100 oC will result in a 1.8-2 μm diffusion well.

The wafers are stored in a wafer-box, which is stored in a desiccator. When taking a new wafer from the dessicator make sure you have an empty wafer-box on hand. Wear a mask and limit the time that the new wafer is exposed to the clean room atmosphere. When carrying the wafer around in the microfab, use a wafer-box. This limits contamination of the wafer surface.

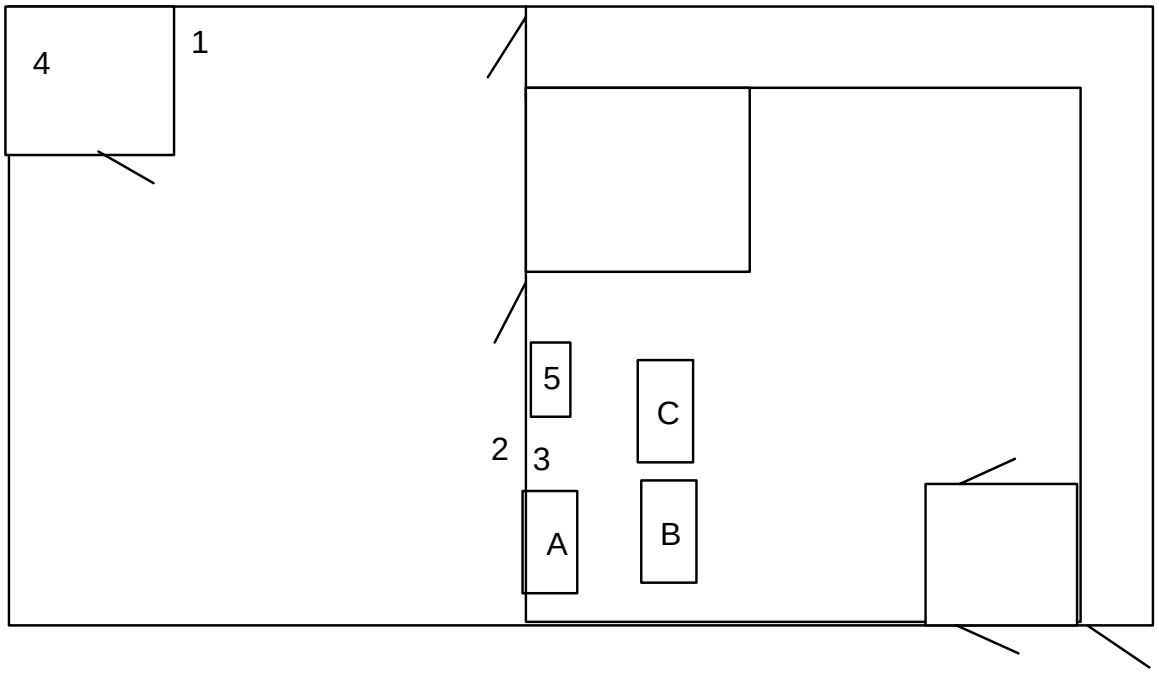
BOE:

- 6:1 or 10:1 BOE
- Life time is better than 20 wafers
- If you would like to replace the BOE you can dispose the BOE in the little BOE-sink of the etch bench. The BOE-sink is the sink that contains the BOE-bath. Before you dispose the BOE, check under the etch bench if the sink of the BOE-sink is connected to a waste container.
- To remove the native oxide you might need to etch 30 seconds. To remove thick oxide (etching rate is 100nm/minute) or the glass-oxide layer after a diffusion step (1 minute of etching for each 10 minutes of furnace time) you might need to etch five to ten minutes.

- The dangling bonds of bare silicon will catch hydrogen atoms. The result is a surface on which the HF solution will bead as supposed to spread. The HF solution will spread easily on a glassy or SiO_2 surface. The moment of beading is a good end point detection for the etching process.
- After the etching step rinse both sides of the wafer.
- Spin the wafer dry.
- Place the wafer back in the wafer box.

Photolithography:

- There are two types of photoresist available: (1) AZP4620 is very viscous and will give a thick protection layer (you do not need to worry about over exposing the wafer and you have to use SC1 to clean); (2) AZ5214-E has a low viscosity (results in a thin film and can be cleaned with acetone).
- All information below refers to AZ5214-E
- place wafer on chuck, use center tool
- remove center tool
- turn on vacuum
- close lit
- apply 2-2.5 ml of photoresist per wafer with syringe (plastic syringes might be a source of small particle and should be avoided).
- choose the p-program to spin the photoresist (3000 rpm)
- do a soft-bake at 70 ^{o}C (Luke will use 50-60 ^{o}C)
- in order to determine the exact temperature of the hotplate use the Miniterm (tolerance is 5 ^{o}C)
- Expose the photoresist covered wafer: 120-150 seconds for photoresist (2) and 180 seconds for photoresist (1).
- Develop the wafer for 50 seconds in etching bench (2). Use dilluted AZ-400K (4:1) for photoresist (2).
- Perform a hard bake: 1.5 minutes at 60-70 ^{o}C.
- Etch the wafer in etching bench (1). For aluminum use pure aluminum etch for 2 minutes. For oxides or glass use BOE (see above for etching rates).



1 Vacuum Pump
2 Water de-ionizer
3 Valve for de-ionized water
4 Store room with empty wafer cases
5 Blue cabinet
A. Chemical Bench for SC1 clean
B Etching Bench 1
C Etching Bench 2