

# Furnace Use

**General:** The furnace is one of the most important equipment in a fabrication facility as it is used to form gate oxides and dope materials to be chemically active. The furnace is very easily poisoned by impurities. Impurities dissolve into the glass and later release to ruin every sample after initial contamination (students thesis' become ruined). Your peers and friends demand that all rules are followed. There are 3 critical rules.

1. Never put anything that has not been thoroughly cleaned into the furnace. The impurities will diffuse into the glass! The only way to know if a tube is ruined is for several students to fail at their experiment for months and deduce it was a contamination. People who don't follow procedures will be rightfully scorned and facility privileges revoked.
2. Never exchange parts of one furnace (ie. sample holder) to put in another. Impurities (i.e. dopants from one furnace can ruin the other. Keep all items in their labeled positions.
3. Never touch a furnace with your bare hands. The Na/Ca/etc. will diffuse in the quartz and ruin the tube.

There are 4 general types of furnaces. 1) oxidation, this is the cleanest furnace and can only be used to oxidize Si 2) Phosphorus doping, this furnace can only be used to dope selected materials N-type conductors 3) Boron doping, this furnace can only be used to dope selected materials P-type conductors. 4) General annealing, this furnace will be relatively dirty since a large variety of samples will go through it. All proposed experiments outside of standard procedure must be approved before using in this tube. This is necessary to keep the tube functional. Researchers are welcome to provide their own quartz tubes to use in the furnace for specific needs. New tubes and fittings cost about \$2,000. Room 369 has general use furnace recommended for 'dirty' process.

**Safety:** **Dangerously hot quartz looks like cold quartz!!** Never grab/touch quartz without knowing how long it has been out of the furnace or feeling radiant heat from a safe distance. Explosive gasses such as H<sub>2</sub> must be safely diluted. H<sub>2</sub> and O<sub>2</sub> cannot share the same feed line.

**Procedures:** Perform appropriate RCA/Piranha clean before placing samples in furnace! Set furnace to operating temperature. Set gas flows to desired conditions. Slide sample in with quartz rod ensuring that rod only goes in storage tube or furnace. Wear gloves!! Don't mixup parts!! After elapsed time, slide sample to edge of tube with quartz rod. Let sample cool for 10minutes with endcap in place. When sample is cool remove plate/sample from furnace and replace endcap. Turn off heater. It is important that a small amount of gas flow while furnace is cooling, this is because as the furnace cools, air inside contracts drawing in air with dust. Over a short time this dust will contaminate the tube.

**Never, never, never touch quartz tube with bare hands (no gloves). The Na from your hands will contaminate the tube.**