

February 2, 2011

OVERVIEW OF HAZARDS (FOR FULL DETAILS, SEE MSDS)

Beryllium is toxic and carcinogenic. The primary hazard is inhalation of the powder, which can cause chronic beryllium disease and lung cancer. Any items which may be contaminated with beryllium dust must be either collected for hazardous waste (poison) disposal or thoroughly cleaned, with all wipes and fluids used for cleaning going to hazardous waste.

LAB PROCEDURE

WASTE COLLECTION

Princeton collects hazardous waste once per month. Per lab safety guidelines, between pickups we need to keep temporary hazardous waste set aside in well-marked containers. Before beginning work with Be, assemble Ziploc bags for solids and plastic bottles for liquids. These containers should be clearly marked "Be waste" in large letters, kept within reach of waste-generating cleaning, and sealed when not in use. Princeton pays for waste disposal by volume, and they appreciate if we can minimize the volume of waste we generate. For example, contaminated Q-tip ends are hazardous waste, but the uncontaminated wooden sticks can be snapped off and tossed in regular trash. At collection time, bags and bottles may need additional yellow labels to meet Princeton waste disposal requirements. Bob Koenigsmark is in charge of GEO waste and will help on waste pickup day.

GASKET HANDLING

An intact beryllium gasket is not particularly dangerous. Just in case, you should handle solid beryllium with gloves.

PREINDENTING GASKETS

In any situation where the gasket is under pressure, we have to expect the possibility that the diamonds or gasket will break. After loading the Be gasket in the DAC, we close the openings of the DAC with tape. In the case that something breaks and Be dust is dispersed, the tape will contain the contamination to the inside of the diamond cell and we won't have to worry about cleaning the whole lab.

Be is both weaker and more brittle than Re. While it might take 20+ GPa to preindent a Re gasket to 25 microns, as little as 12 GPa is sufficient to preindent a Be gasket to that thickness. Also, take care to increase pressure very slowly on the Be gasket. This will give the brittle gasket time to deform and prevent breakage.

After preindentation, there will most likely be some Be residue on the diamonds. Any Q-tips, etc. used to clean these are hazardous waste.

DRILLING

Some years back, Princeton's chemical safety officers evaluated the amount of Be dust in the air in our lab generated during Be drilling in the EDM. They couldn't detect anything. Drilling a ~100x100x25 micron hole generates a tiny volume of dust, and most of it ends up in the mineral oil, on the gasket surface and on the tool wire. Thus we take great care in cleaning every part used in the Be drilling process.

- Drill wire

Once an EDM drill wire has been used for Be drilling, it is a Be-only wire. We have reserved a few Be-only drill wires that can be reused. These must always be kept separate from the general use drill wires. Once a Be-only wire is damaged, it is Be waste. The wire should be removed from its holder with acetone. Both acetone and wire go in hazardous waste disposal. The holder can be washed (3x) in acetone and/or soapy water and then reused. The solvents used to wash the holder also go in waste disposal.

- Gasket

Before drilling, the Be gasket should be handled with gloves but is mostly safe to handle. The Be gaskets we order can be smaller than the hole in the stage on the EDM. In order to drill, these will need to be glued to a larger piece of metal, such as a steel gasket. A dot of cyanoacrylate (Krazy, etc.) glue works well, but to maintain electrical conductivity some conductive paint may be needed as well. Both of these will easily dissolve in acetone during cleaning after drilling.

After drilling, the gasket must be washed 3x in the ultrasonic machine before it is considered clean and safe to handle. Any gloves, tweezers, hex keys, wipes, solvents etc. that contact the gasket or the drilling stage before it is thoroughly cleaned must either be disposed of as hazardous Be waste or equally thoroughly cleaned. The gasket may first be washed in acetone to remove glue/paint. Once the gasket is removed from the steel backing, it should be washed in soapy water.

- EDM machine

After all Be gaskets are drilled, the EDM drilling stage must be thoroughly cleaned before it is used for Re or other non-hazardous gaskets. Screws, hex key and clamp should be washed 3x in soapy water in the ultrasonic machine. The stage should be wiped down with acetone until no oil or dust remain. The other most hazardous part of the stage is the hole below where the gasket sits. Twisted kimwipe points should be poked into the hole to swab out metal dust. Most of the dust in the hole will probably be Re dust, but to be safe this hole should be cleaned until no trace of black metal dust remains. All wipes and gloves used for this cleaning go in hazardous waste disposal.

GASKET USE

During sample loading and experiments, Be gaskets can mostly be used like any other metal gaskets. The major difference is that we need to use tape to seal openings of the DAC in case the diamond/gasket breaks and produces Be dust. During synchrotron diffraction experiments we use x-ray transparent Kapton tape. In addition, Be gaskets are more brittle than steel or Re, and pressure should be increased slowly to prevent failure.

Take care not to scratch the Be with sharp needles while loading. Upon unloading, diamonds may have Be residue. This and items used to clean the diamonds are hazardous waste.