

Boron gaskets

- 3:2 boron to epoxy (can also be 10:1 for harder gasket, or cBN)
- 1 ton pressure in steel die → pellet
- Polish to 50 micron foil, on fingertip (very brittle, small, sensitive to acetone)
- Laser drill donuts (400 micron for 300 micron culet) @ Yale or outside laser drilling vendor, 80 micron sample chamber for 300 micron culet, poke out center with mechanical drill
- 75 GPa pressure limit in 300 micron culet cell
- Near pressure limit → edges of gasket pierced by diamonds (transparent)
- 400 micron hole in Kapton film, drop gasket disc into hole (it will stay)
- Load sample with acupuncture needles (flexible) to protect brittle gasket from accidental pokes
- Kapton film 0.005 in (?)

Notes on preparation from Lowell Miyagi:

"I actually drill the sample chamber with a mechanical drill. Its actually really difficult to drill the sample chamber with the laser without burning the boron. So what I do is I use the laser to make a mark in the center (on one side) and then drill with the minitool. The mark makes it alot easier to align the drill bit. Just be really gentle.

"The way you assemble the gasket is to cut the Kapton in to a small strip, something like 1.5 mm wide and 3-5mm long. Dimensions aren't too important, you just want the x-rays to go through the thin direction of the Kapton(it actually diffracts alot). Then drill a 400um hole in the Kapton with a mechanical drill. Actually I drill then cut. Its easier to make sure that the hole is centered if you cut second.

"Now make sure the hole in the Kapton is clean...if there are any rough edges just cut them off with a razor blade or pull them off with your needle. Then put the Kapton on a glass slide and put the boron over the hole in the Kapton. One helpful thing is to make sure the boron is "upside down" meaning that the mark in the center is on the bottom (you will see why in a sec). Take another glass slide and set it over the top and push on it so that the boron seats in the Kapton. Now the boron is in the Kapton but is on the top since the Kapton is thicker.

"Next thing you want to do is take a small piece of the sticky part of a post-it note (double sided tape is a bit too sticky). Turn the gasket over and stick it to the post it note. Now the boron should be on the bottom side in contact with the sticky note, and the center mark should be visible and will help you align the drill bit in the center of the boron. You can now put the sticky note in the holder for the drill, but I generally try to put something stiff

underneath like a thick sheet of plastic so that the sticky note doesn't flex when I drill. I use a heavy piece of Kapton but a piece of a hard cd case or something similar is good...just something easy to drill through. Then the only other trick is to be gently when you drill... obviously you can do this however you want this is just the process I found which works.

“When you load your sample just turn the gasket back over and set it on top of the diamond tip. Since the Kapton is thicker than the boron and the boron is on one side of the Kapton, the Kapton will slide over the tip of the diamond. This will self-center the gasket. Oh yeah for a 400um insert you will want to use 300 or 350um flat culets, you can go smaller but it won't self-center. Don't go larger though. Ok now that it's on one anvil close the cell really gently down on the gasket and the boron should slip down into the Kapton until it is in the middle. Don't push too hard or the sample chamber will close up. I generally push on the cell until I see the chamber just barely start to shrink (or right before I think it will) then I open it up. When you push on it you may see the gasket crack a little and this is pretty normal. As long as big gaps don't open up the crack will "heal" when you start to compress.

“When you load I look for a clump that's about the same size as the sample chamber and put it on top of the hole and gently close the cell to push it down. I do this until it looks full from the other side. You don't want to overfill it or it will squirt out the side, particularly if it is soft like NaCl or a lot of metals. For these guys I slightly underfill the chamber so that it shrinks slightly when I compress.