Modified design for dome support

3/22/2016

I have been working on a new design in which the glass is supported by a kapton ring on the bottom, and by resin on the periphery. This purpose of this design is to make assembly easier (compared to having resin on both surfaces, or Kapton on both surfaces) and to provide an even support for the glass. The coupler ring will be made out of titanium. Stainless steel was first considered but the large difference in coefficient of expansion with the glass makes it inappropriate. The design relies on tensile stress in the titanium ring to cancel out the radial force exerted by the glass. FEA has shown that at 1500m and 4^{o}C, the radial displacement of the titanium is close to zero.

Assembly procedure:
- All components (titanium rings assembled with aluminum dummy endcap, and glass port) are placed in the oven overnight at 30^{o}C.
- Titanium rings are placed on a work bench, dome seat facing up. Ideally, the operation should be done in a room where the temperature is 30^{o}C.
- Kapton gasket is placed on the titanium ring.
- Glass port is placed on the kapton ring, and 0.020" shims are placed in the groove around it to center it.
- A vacuum is pulled on the housing, resulting in about 1000 lb force on glass (I tested this using the old kapton gasket, it held a vacuum for several hours).
- Shims can be removed
- Epoxy resin is inserted in the groove using a syringe (I am currently experimenting with the process, and it seems to work well)
- Once the groove is filled, the assembly is placed in the oven at 30^{o}C for several days (until material has fully cured).

Operation:
- During operation at 1500m and 4^{o}C, the contraction of the ring due to temperature will compensate the contact force applied by the glass on the OD. This will result in no radial displacement of the glass and very little to no tensile stress in the glass. The compressive stress on the resin will be approximately 3000PSI, well within the margins of what it can tolerate.
The resin will never be put under tension, unless the temperature exceeds 30^{o}C.

Things I need to spend more time on:

-practice resin application on test pieces. Experiment with other resins.

- refine FEA. Have Berkeley student work on FEA with other tool. Have Jon Erikson verify my work

- Finalize design, make drawing and order parts from the machine shop.

- I am interested in testing another dome, using a kapton ring on both surfaces, but I doubt this solution is feasible due to the very tight machining tolerances required and the difficulty in assembling. Also, it would require the dome seat to be polished flat. An option, for now, is be to make test pieces out of less expensive materials to see if assembly is practical or too difficult.

- Work with Berkeley students on proof testing protocol (for prototype, and for subsequent pieces)