# Status of machining of tiles at UCR

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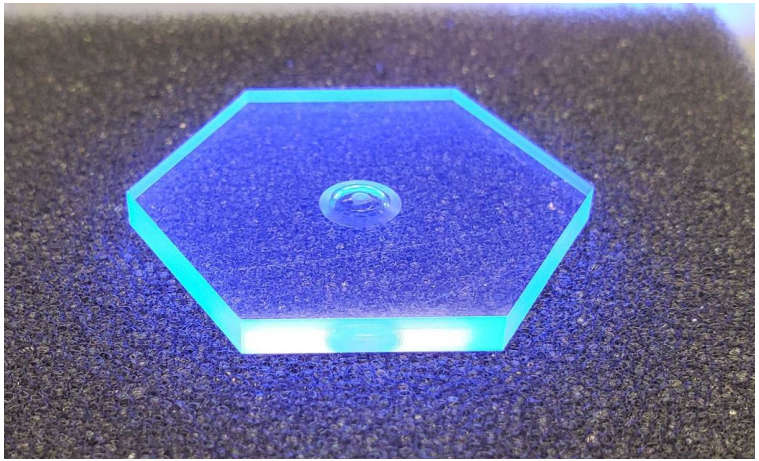
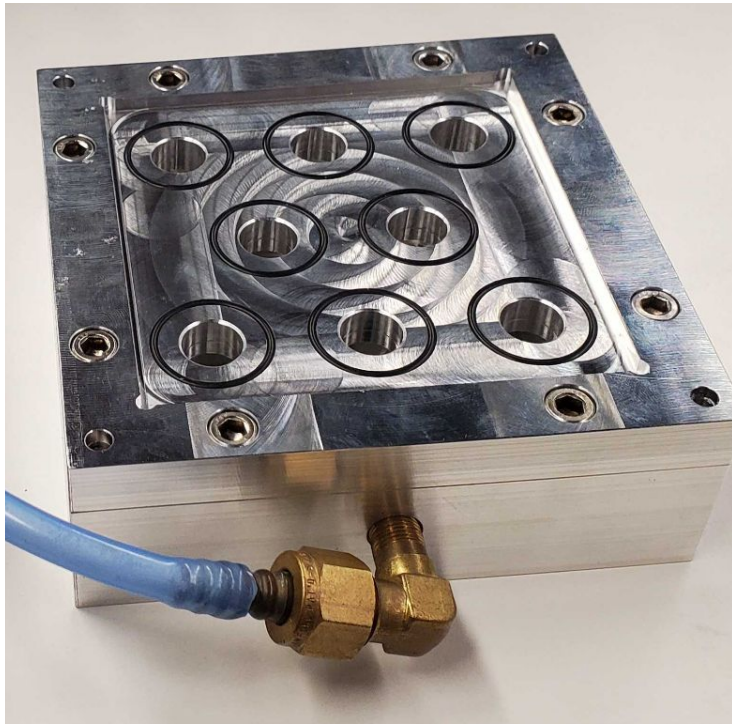


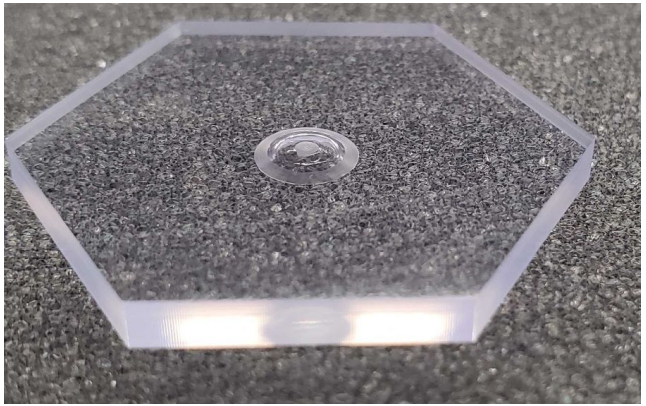
# How we manufacture the cells at UCR

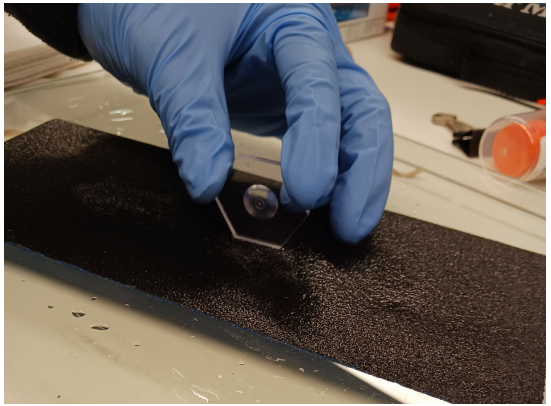
From EJ 212 raw material (square 10x10 cm2), we get ~8 small cells.
These are milled while in a custom vacuum chuck.

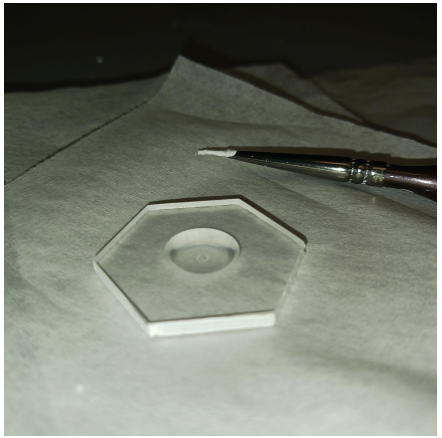



# Polishing & Painting

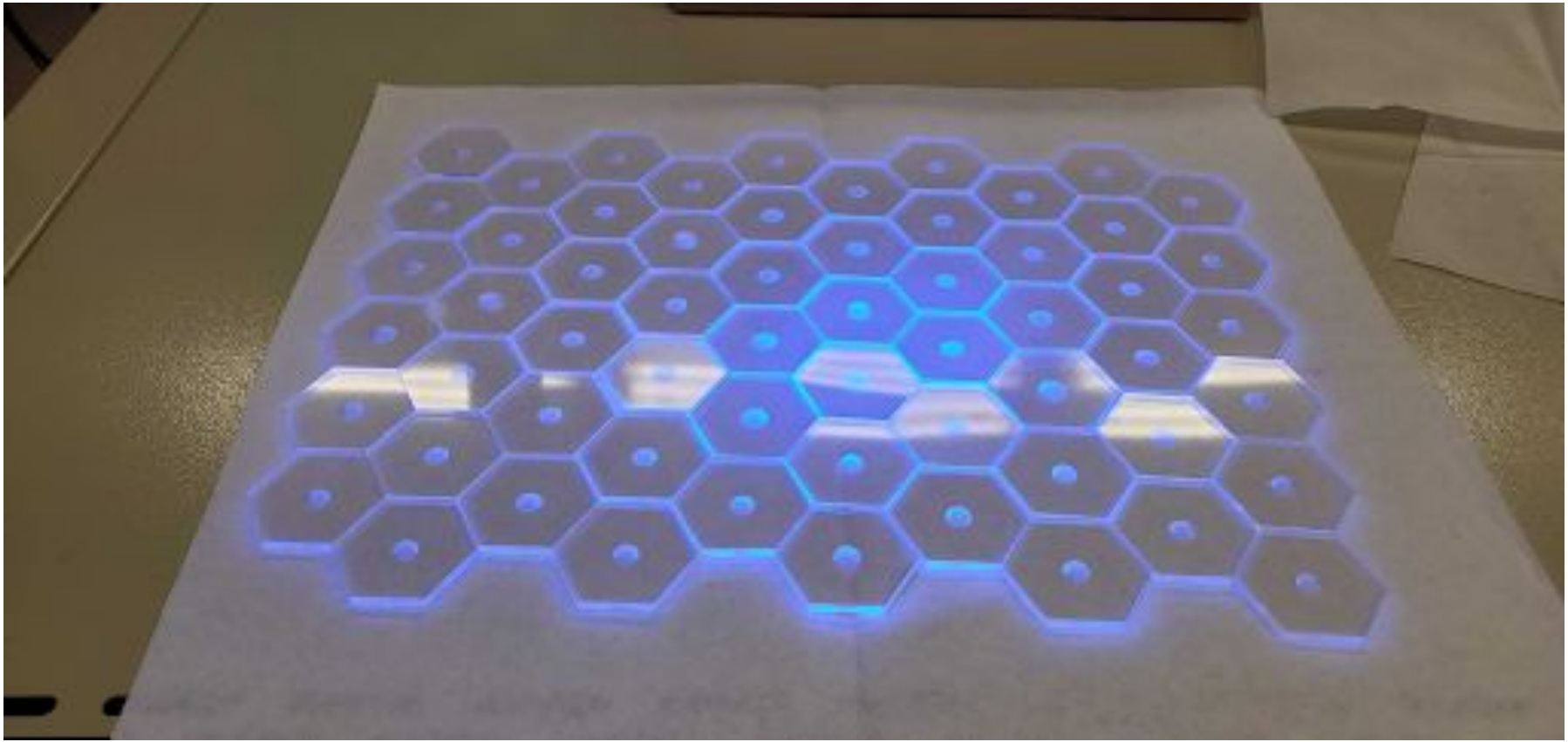
Edges & dimple are hand polished,
Edges painted with Saint-Gobain BC-621 paint



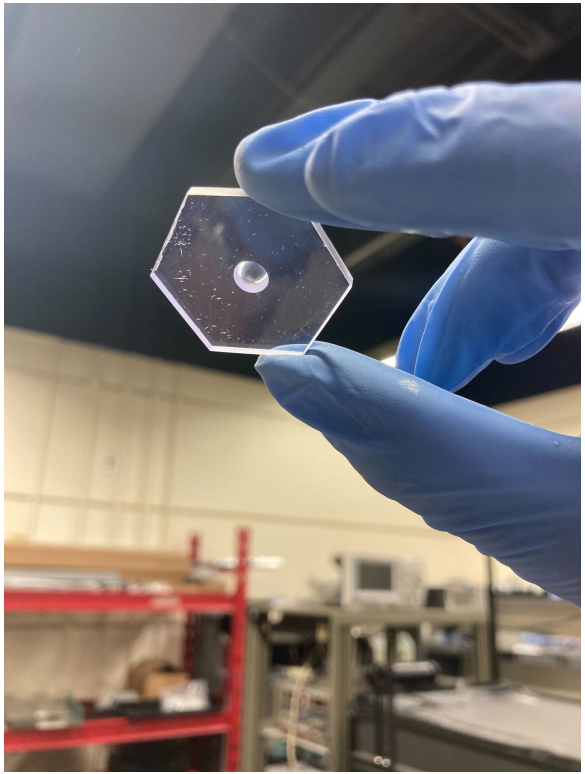


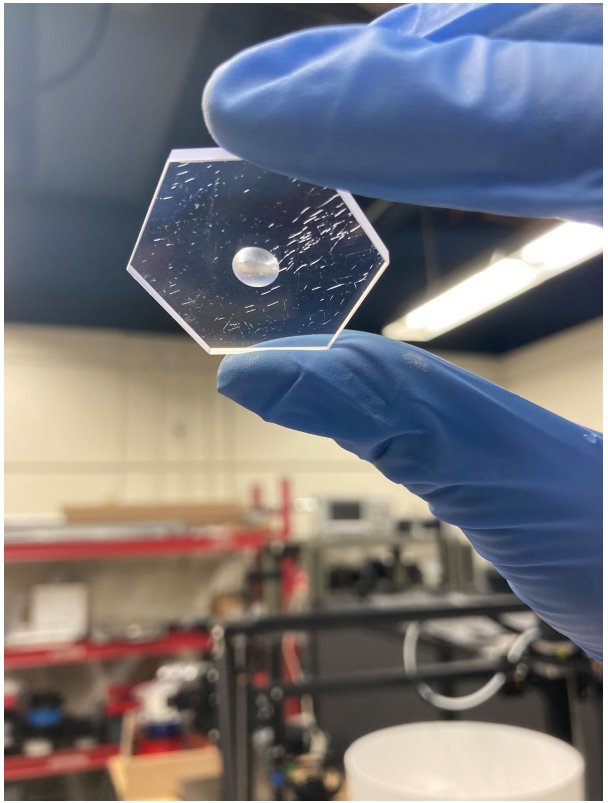


# Machined tiles looked beautiful at first

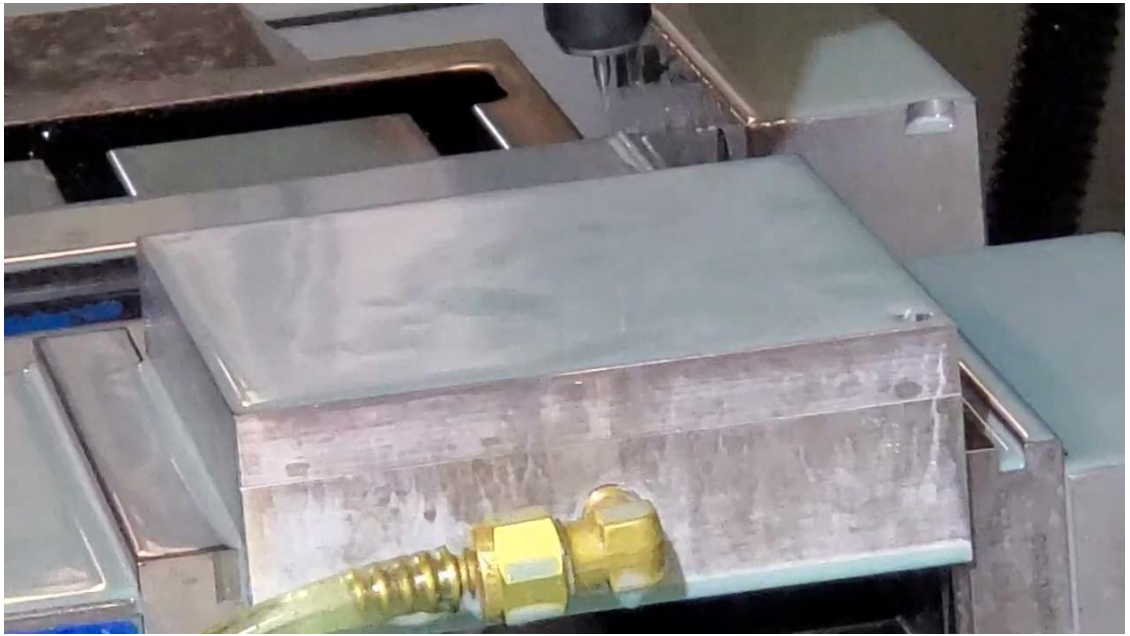


# But after a while (weeks), we started noticing crazing



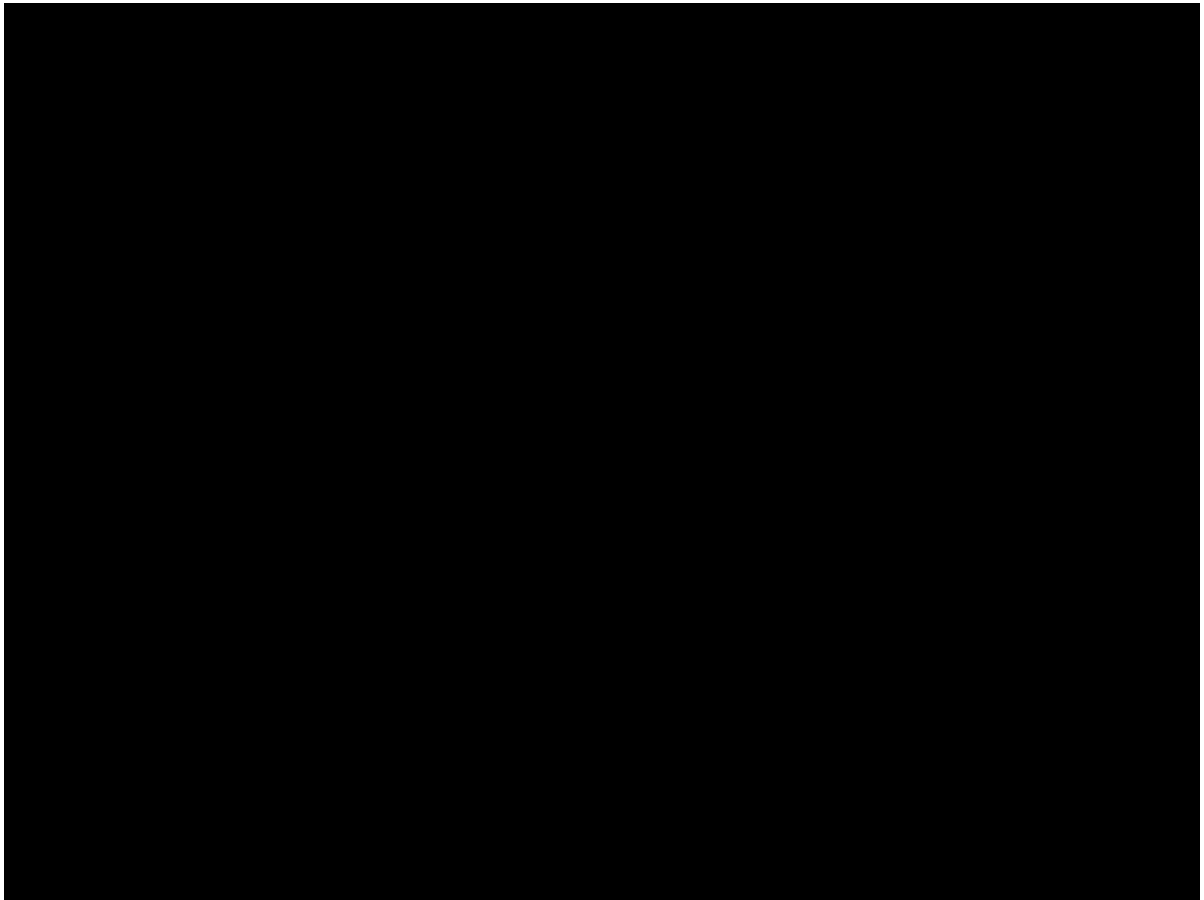


Likely culprit: Traced that our machine shop was using standard coolants , and “scraping” piece afterwards by hand.



# New method: submerge in water while in vacuum chuck

we got rid of most obvious culprits (we are not using chemical coolants, or compressed air, or alcohol, or clamping of any sort)



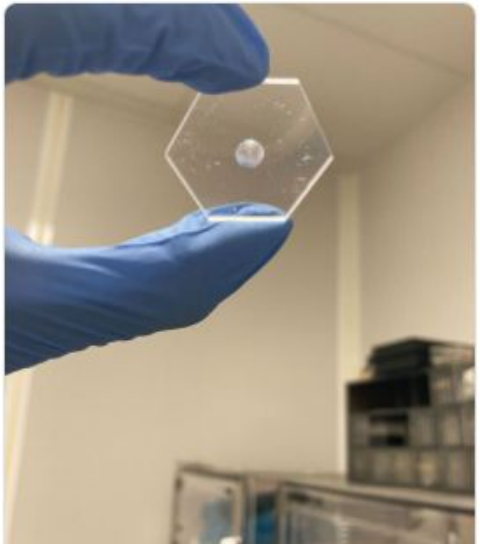
the dimple: They are using a ball nose end, at about 7500 rpm, 55 inches a minute. 0.001 inch chip thickness

# Bad news, newer method still produces crazing (but later than old method)

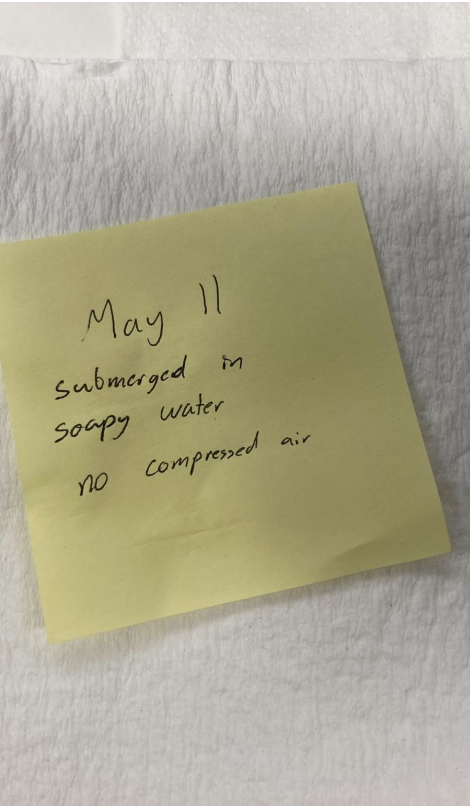
**Miguel Rodriguez** 5:04 PM

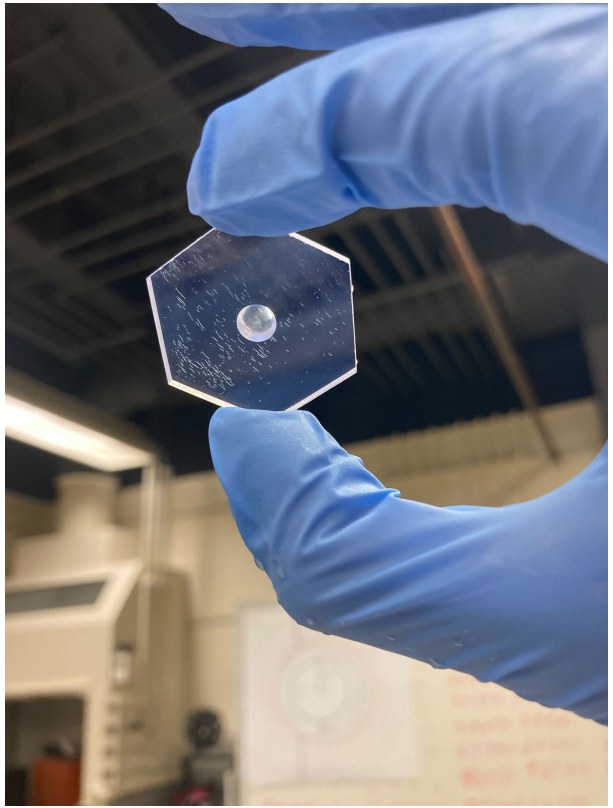
There are many scintillators created last week done by the old method in the clean room that are already showing crazing. This doesn't apply to the ones created in the new method.

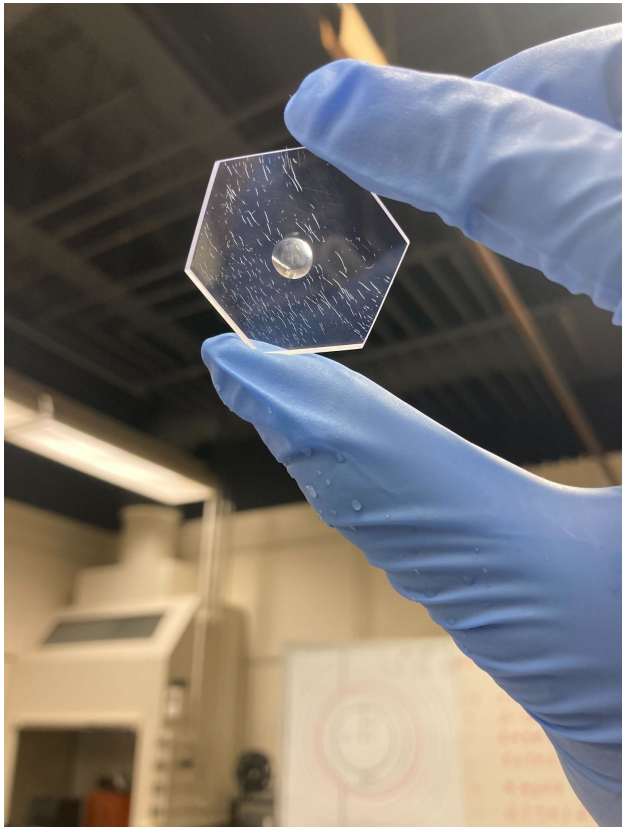
IMG_4694



Batch made with refined method (submerged in water for cooling, no compressed air) shows this level of crazing after ~1 month



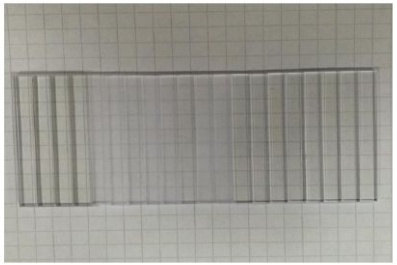



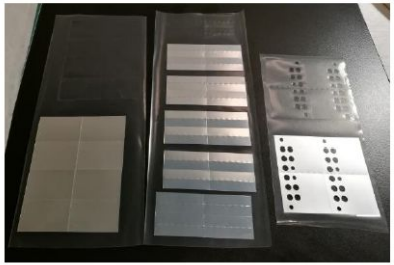


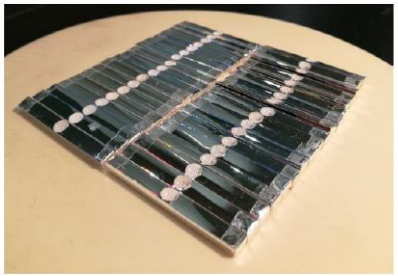
# Got the idea of annealing tiles from work by CEPC/CALICE on SiPM-on-tile strip ECAL

## Scintillator modules

Cutting → Grooving → Polishing → Annealing → Cleaning → Packing



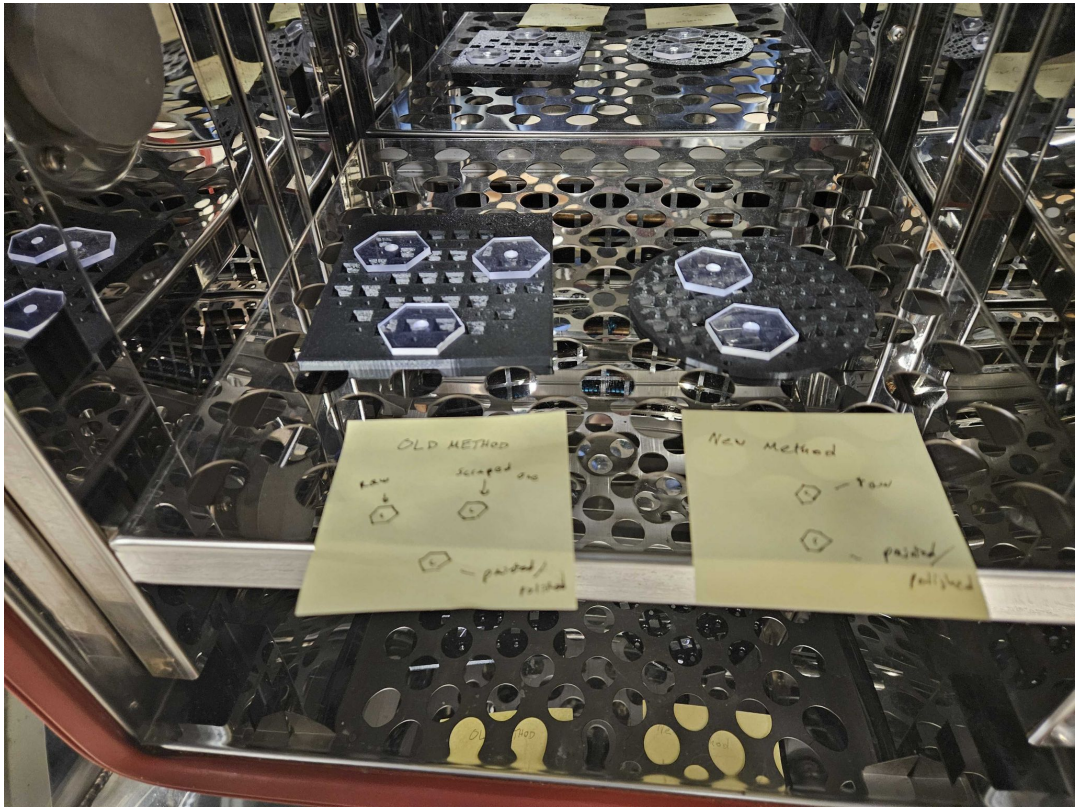


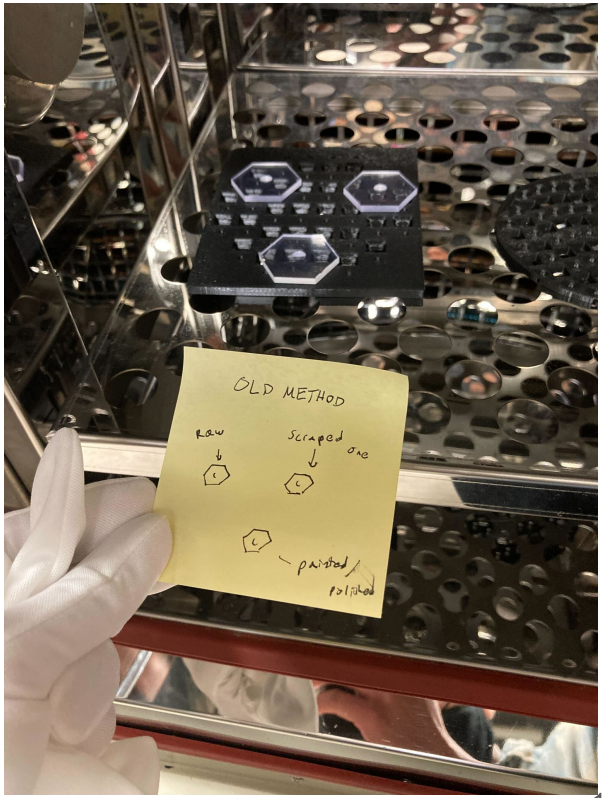


Scintillator strips were produced and wrapped in the SIC (Shanghai Institute of Ceramics)

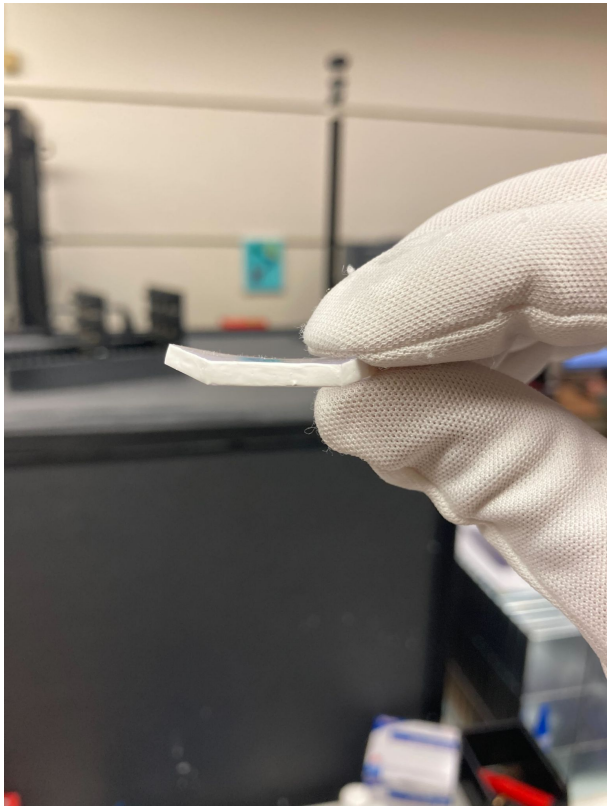
We suspect that annealing of the scintillator might help with the crazing

# We used our climate chamber to test approaches



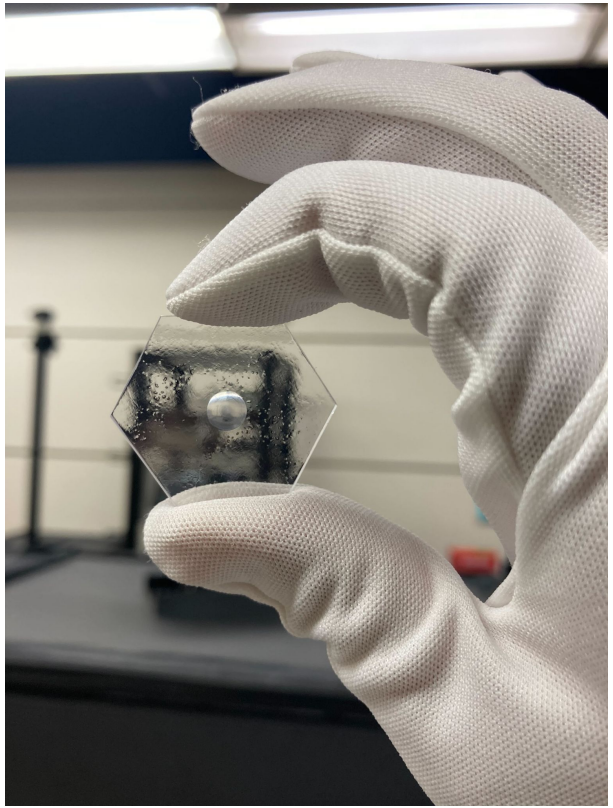
# First try at annealing (48 hr, 80 C)



Some warping seen in the scintillator tiles (right one)

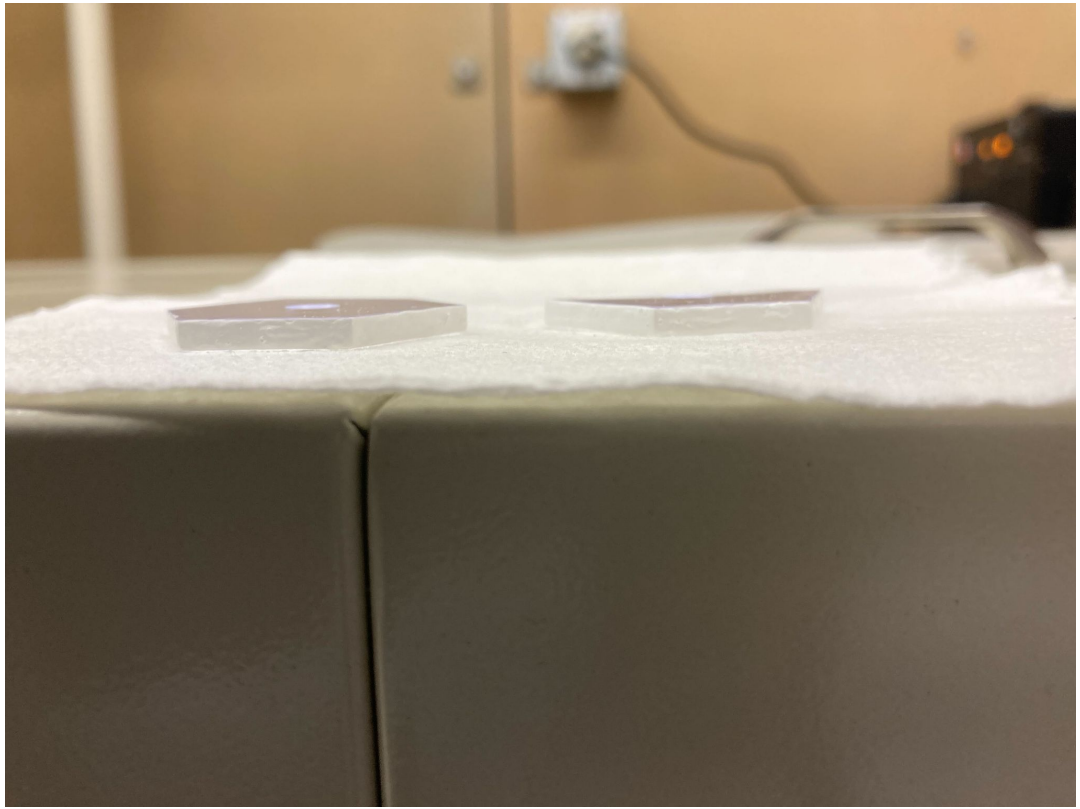
→ This was too much

# First try at annealing (48 hr, 80 C), continuation



Crazing is gone, but some texture appears
→ This was too much.
We also changed the resting surface to soft cloth (from plastic)

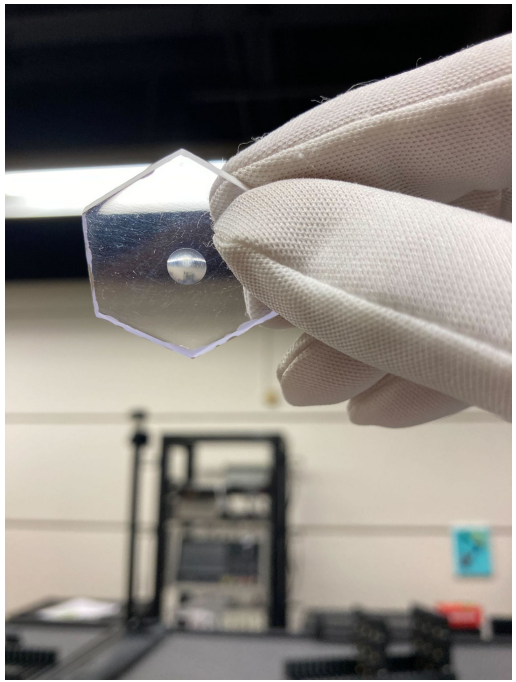
# Second try (12 hr, 80 C)

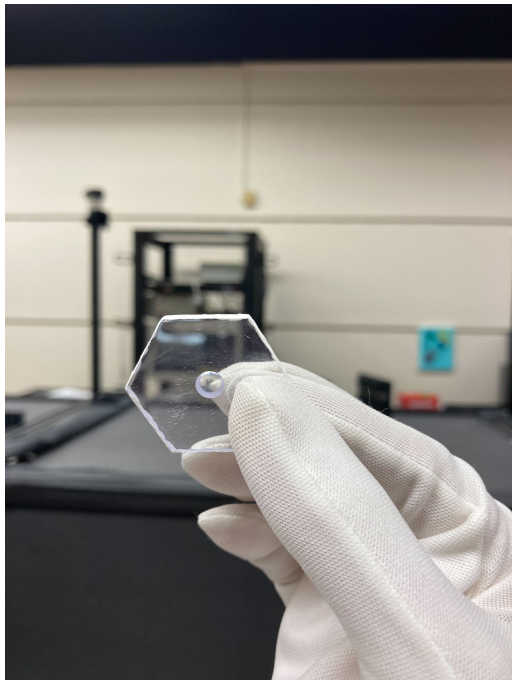


Some warping seen in the scintillator tiles (right one)

→ This was too much

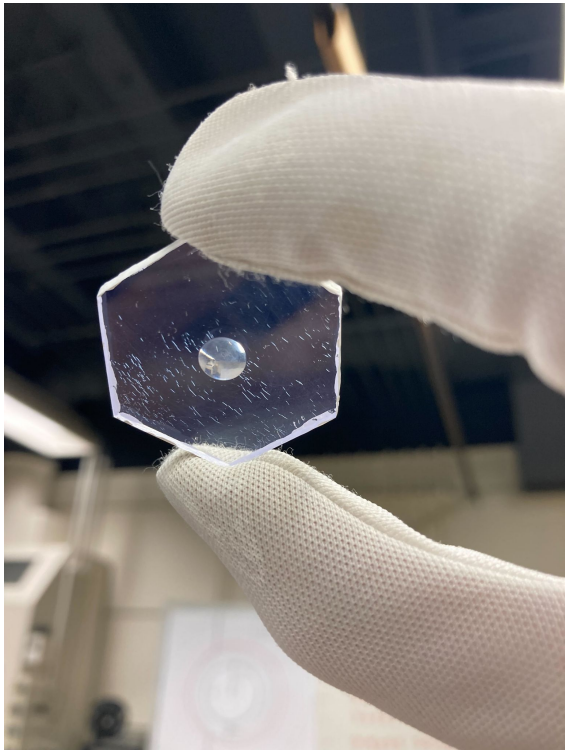
# Second try with another pair (12 hr, 60 C)

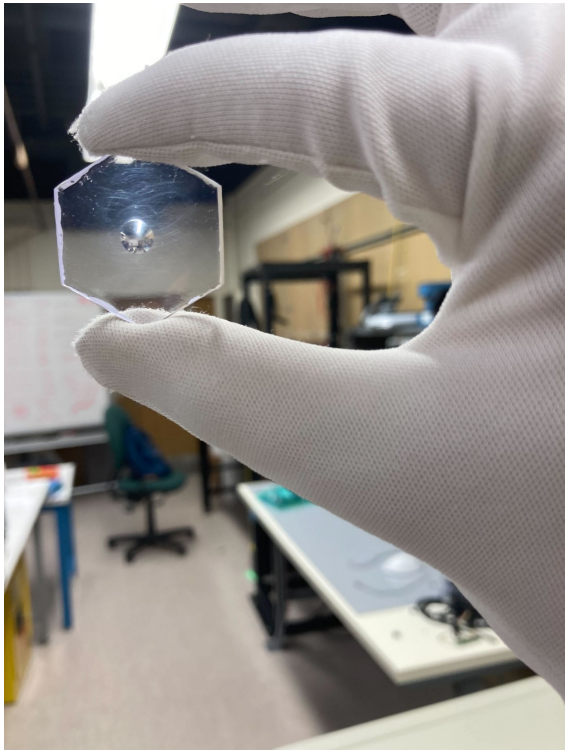




No warping or texture added to scintillator but crazing still there

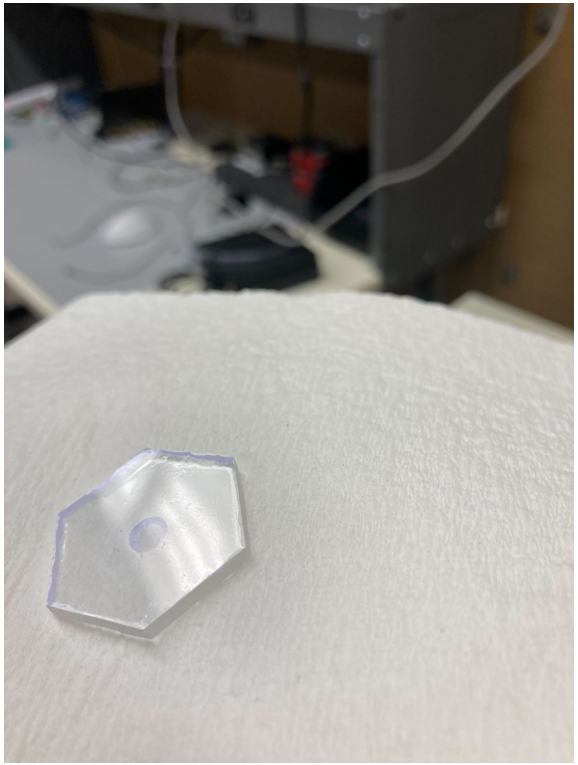
# Before and after annealing (4 hr @ 80C)

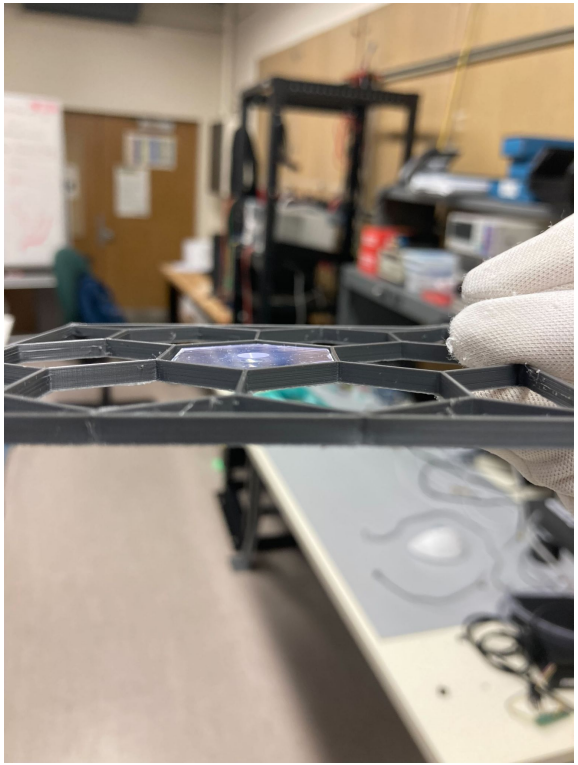




Crazing goes away with annealing, no evident trace of it. We will keep the tiles using these tests under observation

# No noticeable warping or texture in the scintillator with the annealing (4 hours, 80 C)





# Summary

- Current method for machining EJ-212 is with CNC, water-only coolant, custom vacuum chuck (to avoid clamping), and no compressed air or any other chemical.
- Still, some crazing is visible some time after machining them.
- After some iterations, we found that 4 hr @ 80C of annealing removes the visible effects of crazing and has no secondary effects (like warping or additional textures)