Objective: Smooth, transparent channels of defined depth and profile to be used for microfluidic devices.

Problem: Non-isotropic wet etching of borosilicate glass (left.)

Process:
- Starting material - Corning 7740 borosilicate glass wafers.
- Polysilicon was deposited as a hard mask (P620Poly recipe)
- Standard 1.6 micron photoresist/lithography
- Silicon hard mask etch using the Samco (CH4:O2 at 10:1 flow, 250W, for one minute)
- Wet etch using 6:1 BOE:37% HCl at a 4:1 v/v ratio and diluted again with 4X DI water, for 5 minutes.

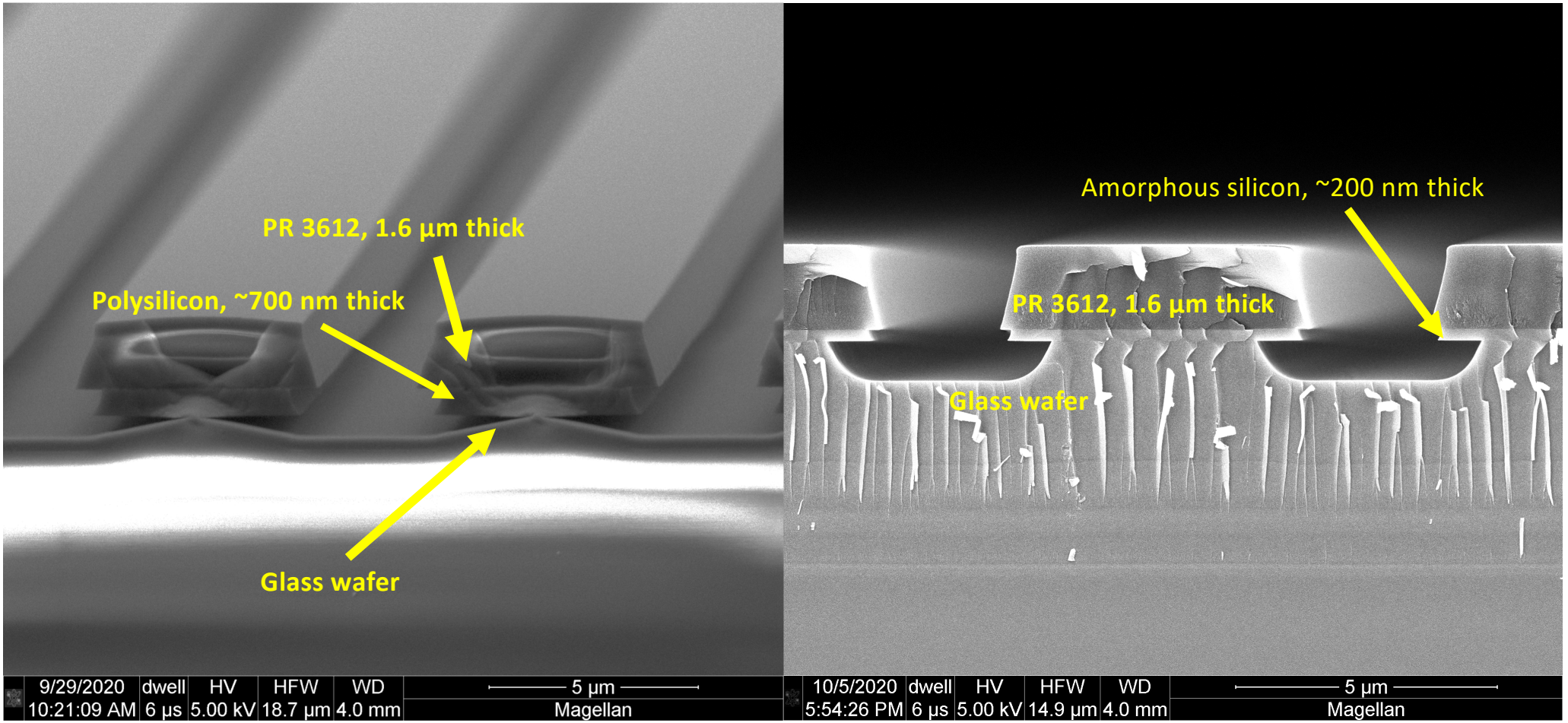
Issue: Adhesion of the hard mask to the substrate. Just because it sticks doesn't mean the film is doing its job as a hard mask. This stress can exceed the adhesion strength of the film under certain conditions. Here, the stress is apparent at the hard mask/substrate interface, which results in a faster etch rate.

Solution: The solution is to either reduce the film stress or increase the adhesion of the hard mask, or both. Two changes were made to the process above.

1. Use of amorphous silicon rather than polysilicon (P525Poly recipe.) Amorphous silicon is thought to have less stress on borosilicate glasses than does poly.
2. A dip in 49% HF prior to AmSi deposition. The surface of glass may contain contaminants or stress due to polishing (for ground glasses) or different composition from bulk glass, due to segregation (for float glasses.) (Both are often seen in microscope slides, which work well until you try to fab with them.) Removing the surface often improves adhesion. It may also increase surface roughness, so should be done carefully in those applications where this is important.

Following these two changes, the desired result was achieved.

(Many thanks to Yao-Te Cheng for the story and the photos!)
Date: 10/2020


PR 3612, 1.6 µm thick
Polysilicon, ~700 nm thick
Glass wafer
9/29/2020 10:21:09 AM
dwell 6 µs
HV 5.00 kV
HFW 18.7 µm
WD 4.0 mm
5 µm
Magellan
Amorphous silicon, ~200 nm thick
PR 3612, 1.6 µm thick
Glass wafer
10/5/2020 5:54:26 PM
dwell 6 µs
HV 5.00 kV
HFW 14.9 µm
WD 4.0 mm
5 µm
Magellan