



Establishing HARE SQ Protocols at QNF Delamination Testing of Soft Litho Masters



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Objectives & Background

New Standard Soft Litho Process

- SU-8 2000 series was discontinued in early 2025, and the future availability of other SU-8 series varieties is uncertain
- QNF staff already had started reassessment of soft lithography process flows after equipment relocated to a new location in the lab in early 2024
- QNF stocked HARE SQ, an equivalent replacement, but did not have significant internal process data/ testing

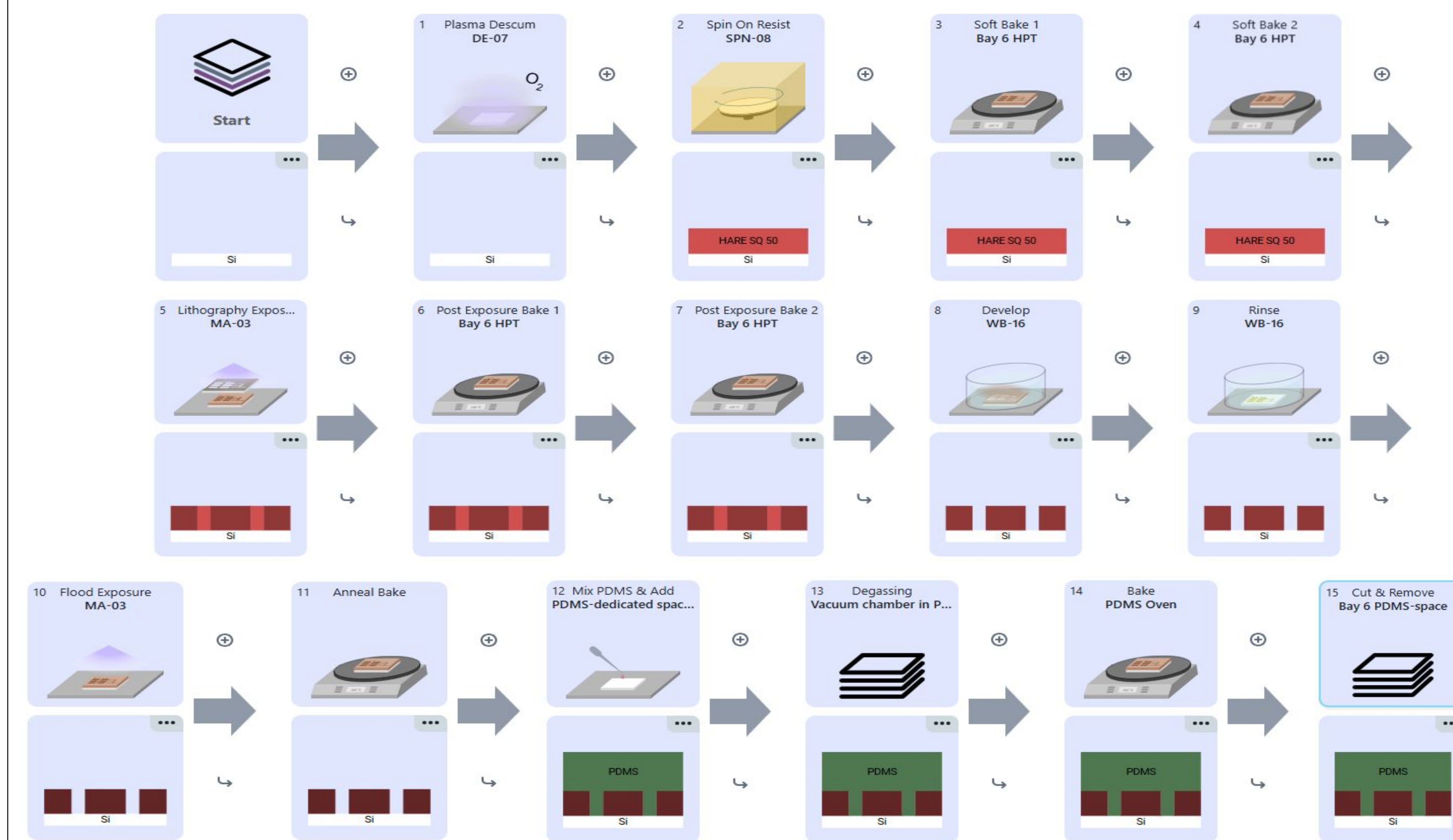
Address Delamination Issues

- Initial internal tests on HARE SQ used the previous SU-8 2000 series protocols as first recommended
- Initial tests saw issues with delamination and degradation, with masters not lasting past a single de-molding of PDMS
- Feedback from Kemlab suggested an oxygen plasma treatment, but needed further testing

Set Up QNF Soft Lithography Foundry

- New foundry being considered in response to demand from affiliate labs for fabrication services for masters
- Needed to establish and prove a new process with HARE SQ as reliably successful and able to withstand repeat de-molding before making foundry services available

New Standard Soft Litho Protocol!



Images taken from "Microfluidics at QNF" Process on FabuBlox - <https://www.fabublox.com/process-editor/70e6195b-900a-48e8-8b05-70dd807d973f>

Methods

Delamination Testing Process

- Test variables were plasma treatment, resist series, mask material type, and feature size

Mask 1 = Chrome on glass, design with large features

Mask 2 = Ink on film, design with small features

Resist 1 = SU-8 3050 (known for great adhesion)

Resist 2 = HARE SQ 50

- Control** = Mask 1 + Resist 1

- Process steps kept constant included a flood exposure step to ensure that all test structures had similar effective doses
- After fabrication, masters went through a repeated process of PDMS application, curing and removal, until delamination or five (5) rounds of testing, whichever came first

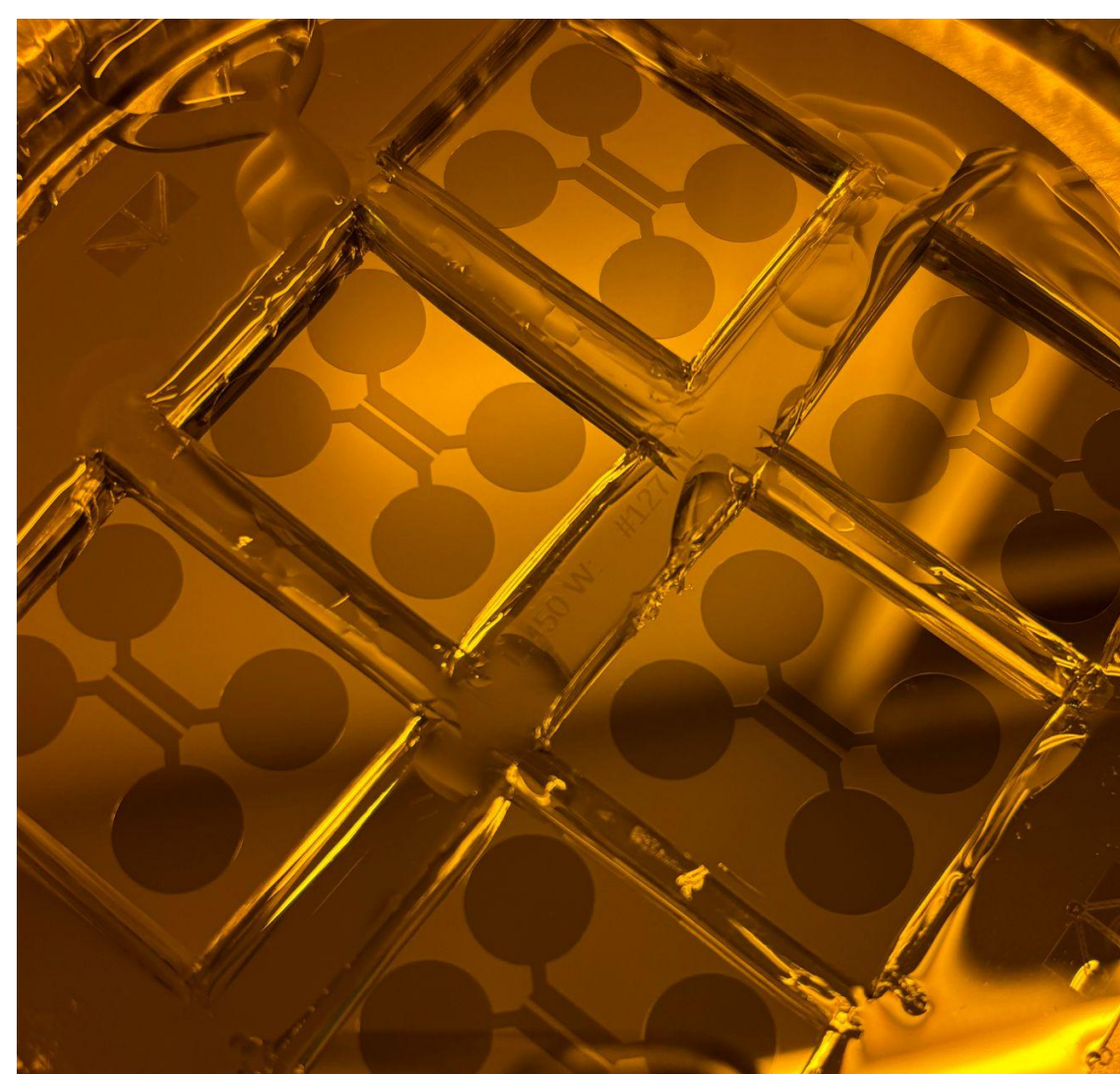
Introduction of Plasma Treatment

- Previous SU-8 2000 protocol included a dehydration bake before spinning on resist, but HARE SQ quickly delaminated
- A plasma treatment was added before, after, and instead of the dehydration bake
- Plasma treatment instead of a hot plate was immediately most successful and included for subsequent experiments.

Results

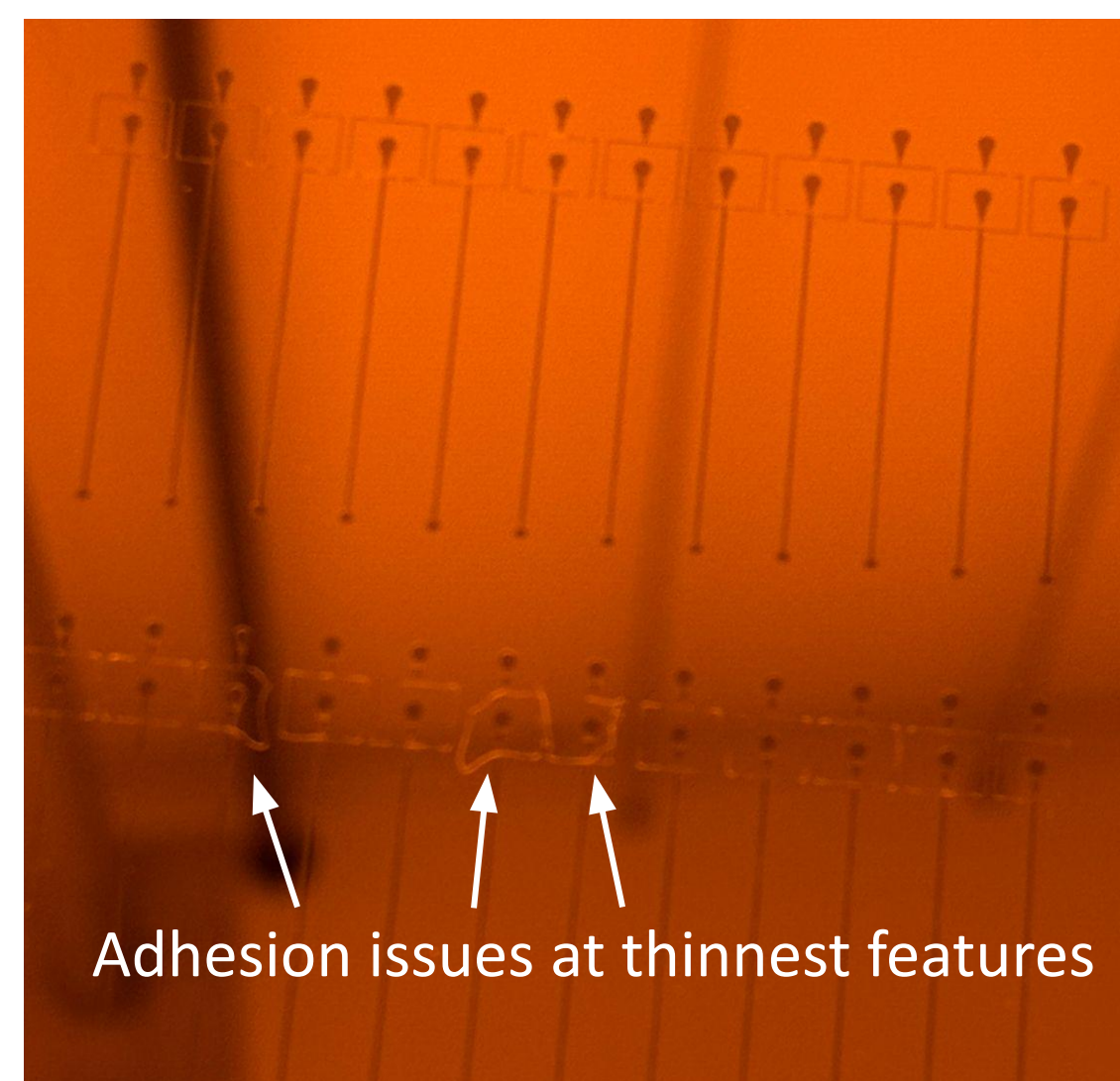
Mask 1 + Resist 1 (Control)

2 masters total
Reached stopping point of 5 rounds PDMS



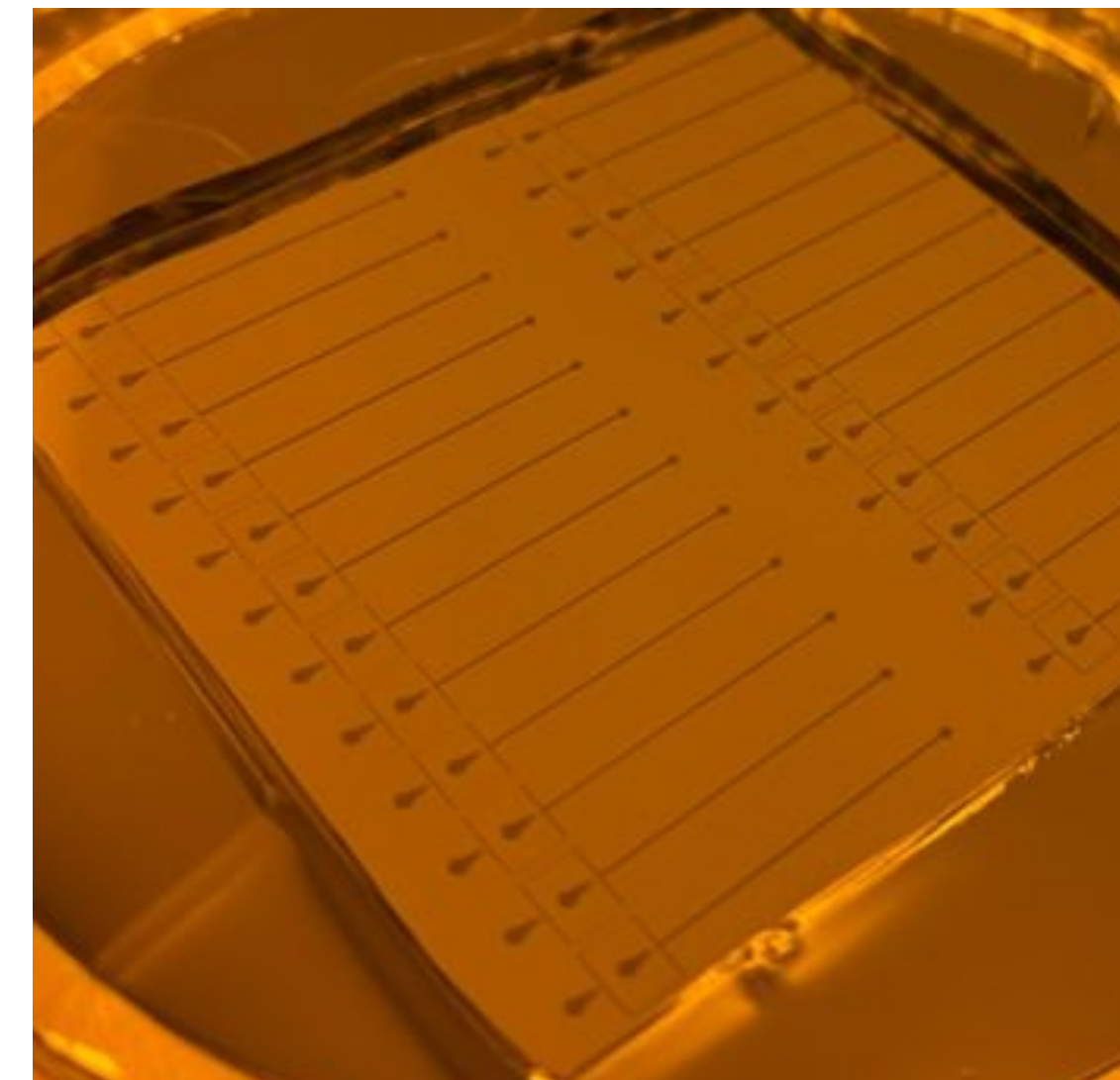
Mask 2 + Resist 2, Trial 1

2 masters total
None sent to PDMS testing



Mask 2 + Resist 2, Trial 2

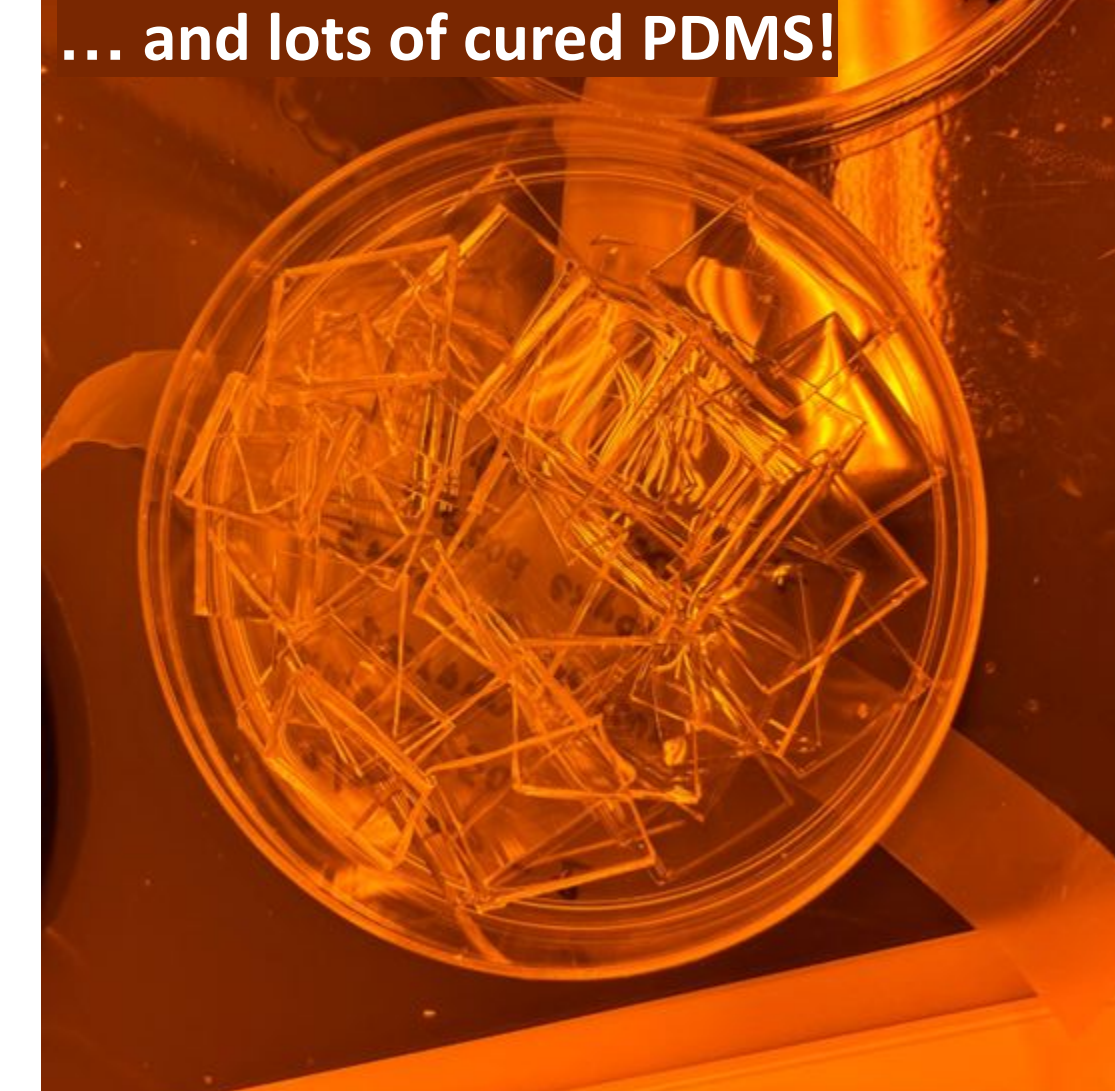
2 masters total
Reached stopping point of 5 rounds PDMS



Mask 1 + Resist 2

Mask 2 + Resist 1

Not tested due to conclusive results
... and lots of cured PDMS!



Conclusions

Delamination issues eliminated by replacing dehydration bake with plasma treatment

Benefits seem linked to both the oxygen plasma descum and vacuum environment, which efficiently dehydrates the wafer surface at the same time. This state is not long lasting, and so plasma treatment should be quickly followed by the spin step.

New protocol independent of resist, mask type

Using the test process with a plasma treatment, there was no difference seen in between masters made with SU-8 3050 and HARE SQ 50 nor between glass and film masks. This allows most users to start their processing with one standard protocol.

Feature size impacts delamination probability

The initial adhesion problems with Mask 2 occurred only with high aspect ratios. Greater care during fabrication addressed these issues in subsequent trials, but whenever possible, designs should minimize use of such features to improve adhesion.

Next Steps

- Internal report to be written up to document these results. QNF standard protocol updated to include the plasma treatment and flood exposure, added to FabuBlox and Wiki.
- QNF Soft Lithography Foundry cleared to begin projects in October 2025. Lessons about role of feature size in delamination will be incorporated in assessment process for client designs.
- Standard protocol to be confirmed on newly acquired DMO MicroWriter ML3 Pro as well as confirming results with thinner resists (~5um)

Acknowledgements

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