## Thermal Nanoimprint Process

1. Imprint substrate clean – Hamatech Hot Piranha Program 1 Wafer Clean
2. Dehydrate – bake at 170C hotplate for at least 10 mins
3. Line the spinner in the e-beam room with beta wipes; these resists are not allowed down the drain!
4. Apply UL1-1000nm XP underlayer resist – 5000rpm, 1000rpm/s, 1min ->900nm (if spin speed is less than 4000rpm, resist will be inhomogeneous)
5. Soft-bake at 175C for 5min
6. Apply SIPOL-200nm thermal imprint resist – 3000rpm, 500rpm/s, 30s ->200nm
7. Soft-bake at 100C for 2min
8. Log into the Nanonex on Coral.
9. Log into the computer: **User: engineer PW: nx2500**
10. Log into the nanonex software (Nanonex Nanoimprint Machine Control V3.7, on the desktop) using the same username and password. When it asks if you want to do UV imprints, select "no."
11. Stretch large silicone disk across metal ring, fix with magnets – make as flat as possible.
12. Clean the template by rinsing acetone, IPA, DI water and N2 blow dry it.
13. Load: small disk (on the bottom), substrate, template (on top), large disk on ring. Make sure the springs in the Nanonex drawer are completely under the large silicone disk ring.
14. Set imprint parameters: pump time 2min; pre-imprint temperature 100C and pressure 400psi; imprint 140C, 400psi, processing time 2min; venting temperature 30C.
15. Hit start.
16. Template removal: use razor blade with caution as quartz chips easily. Be careful, and try to use a razor blade as little as possible — the resist you scrape up will end up on the edges of your template. Slide the blade in between the template and the wafer and carefully pry them apart.
17. SEM the resist profile and decide the etching time for descum etch and underlayer etch
18. SIPOL-200 descum etch – Oxford 82, 30 sccm CF4, 15 mTorr, 50 W, 4-5 min; if the plasma doesn't light, set the low-pressure strike parameters to 60 mTorr strike pressure, 10 V DC bias, ramp 10 (rate: ~30nm/min) (note: make sure that SIPOL residual resist is completely etched away otherwise it will form porous SiO2 after underlayer etch and it can only be cleaned by solvent such as remover-PG)
19. UL1 underlayer etch – Oxford 82, 50 sccm O2, 15 mTorr, 50 W, 20 min, set the low-pressure strike parameters to 60 mTorr strike pressure, 10 V DC bias, ramp 10 (etch rate: ~55nm/min)
20. Substrate etch - This etch transfers the pattern from the underlayer resist into the substrate.
    a. For Si substrate, Unaxis

        i. Photonics Etch, (NICKZOR1) rate: ~135nm/min, selectivity: ~2:1.
           Or
        ii. Bosch deep Si etch (0Trench), rate: ~0.28um/loop, selectivity: ~25:1.
    b. For $SiO_2$ substrate, Oxford 100
        i. $C_4F_6$/high He oxide etch, rate: ~270nm/min, selectivity: ~4.5:1
        ii. $CH_2F_2$/high He oxide etch, rate: ~150nm/min, selectivity: ~3:1
    c. For $Si_3N_4$ substrate, TBD

21. Inspection – optical microscope, AFM or SEM
22. Remove residual resist – immerse in remover PG bath for several hours and sonicate for at least 10 min; sonicate in acetone and IPA if necessary.