HSQ PROCESS (6%)

1. Spin Dischem-AQM HSQ, 6% solution in MIBK
   Bake at 120°C for about 2 minutes. The bake time and temperature are not critical. Note that Dow HSQ, now discontinued, did not require baking. Baking improves the adhesion of Dischem HSQ.

   Approximate thickness of 6% HSQ spun at 3 krpm: 100 nm – *after exposure*

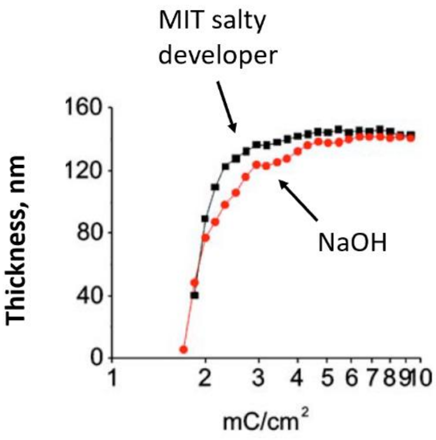
   Confirm this with a profilometer after scratching the film with tweezers. Use a light pressure setting on the profilometer, to avoid scratching the film. The resist will shrink about 6% after exposure. For a more accurate thickness measurement, you should expose some large rectangles, then measure the thickness *after* exposure and development.

2. Expose at 100 kV
   Typical large-area dose when using MF312 (TMAH) developer: 1000 μC/cm^2
   Typical large-are dose when using the MIT salty developer: 4000 μC/cm^2

3. Develop in MF312, which is a strong photoresist developer, a solution of TMAH in water. Develop for 4 minutes or more, then rinse in water. Blow or spin dry.

   Alternatively, for high resolution patterns use the “MIT salty developer.” Develop for 4 minutes or more, then rinse in water. Blow or spin dry.

   Note that the development process is self-limiting, so there will be very little change after 4 minutes.



   If you need to mix more salty developer, here is the recipe:

   1 liter water
   40 g NaCl
   10 g NaOH

   This solution can be discarded in the base waste bottle, or it can be diluted and dumped down the drain.

   Some people claim that 25% TMAH does less damage to aluminum nitride substrates, but they have no evidence or references. This assertion may be entirely apocryphal. If you use 25% TMAH, the required dose will be in the same range as that of salty developer. Note that

25% TMAH is very hazardous. It will cause burns and poisoning upon contact with skin. Full PPE and extreme caution are required. Also note that 25% TMAH goes bad by precipitating out of solution. Use of hot 25% TMAH is simply insane. Do not do that.

4. Stripping: HSQ cannot be removed in solvents. It can be etched in HF mixtures such as 10:1 water:HF or BOE. It can be etched away in any sort of fluorine plasma, such as CF_4. If these techniques will harm your substrate, then consider using a bottom layer of PMMA with a top layer of HSQ. Expose the HSQ, develop, then etch through the polymer with an oxygen plasma. After etching or whatever, you can strip the HSQ in NMP or acetone. Many other polymers can serve the same purpose; some can also be used as an etch mask.

5. For more information on HSQ development, see
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CSAR PROCESS

CSAR resist from Allresist gmbh is very similar to ZEP, but it costs a lot less. It is a copolymer of methyl methacrylate and alpha-methyl styrene. Physically this resist is similar to PMMA, but it has better etch resistance because it has a higher glass transition temperature. That means you can hit it with a higher power plasma before it melts. The etch resistance is not dramatically higher than that of PMMA, so don't get your hopes up. Note that CSAR and ZEP swell a lot more than PMMA during development, and so CSAR and ZEP will form stress cracks if the resist film is more than about one micron thick. We stock CSAR that spins to 400 nm. If you need a thicker film, use PMMA.

1. Spin CSAR. "CSAR 62" also known as "AR-P 6200.13" spins to about 400 nm at 4 krpm. Or you could use the thinner solution found in bottles labeled "CSAR 150". The thinner solution spins to 150 nm at 3 krpm. Spin for one minute or until the film looks uniform.

   Bake at 180°C for 2 minutes on a hotplate. Bake time and temperature are not critical. Confirm the thickness by scratching with tweezers, then using a stylus profilometer (Dektak or Alphastep).

2. Expose at 100 kV. Typical large-area dose is 400 $\mu C/cm^2$
   Be sure to include the standard dose test on every substrate.
   The dose is lower than that of PMMA, but your exposures will not be faster. This is because the e-beam is usually clock-limited, not current-limited. In other words, when using PMMA you simply crank up the exposure current.

3. Development: There are many good developers for CSAR. The YINQE lab does not supply any of them, because everyone has their own random preference. Buy your own favorite developer and keep it in your own lab. Dispose of the waste by following the university's EHS guidelines.

   A typical high-resolution developer is xylene, at 10°C. Keep the developer and a beaker in a refrigerator, or create your own low-temperature bath using a water chiller. Unlike IPA-water developer, xylene must be used in a fume hood. Blow or spin dry. Do NOT rinse.

   Alternatively you could use the same IPA-water developer as we use for PMMA. This is less popular than other developers because it has not been published (probably?)

4. Liftoff: use warm NMP, 150°C after evaporating metal.

5. Etching: low-power recipes used with PMMA will work even better with CSAR. Or, you can crank up the power a bit.

6. Stripping the resist: use warm NMP or an oxygen plasma. Typical parameters for oxygen are: 30 sccm oxygen, 30 mTorr, 200W, 2 minutes.