PMMA Resist Processing
Standard Operating Procedure

These instructions are intended for reference only and recipe optimization is always needed per process and sample needs.

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1. **Introduction:**

PMMA (polymethyl methacrylate) is a polymer used for many imaging and non-imaging applications. PMMA resists consist of the polymer itself dissolved in a solvent like anisole. PMMA is mostly used as a high resolution positive resist for direct write e-beam. PMMA is also used as a protective coating for wafers, as a bonding adhesive and as a sacrificial layer. Standard PMMA products are formulated with 495K or 950K molecular weight resins in either chlorobenzene (notated as “PMMA C”) or in anisole (notated as “PMMA A”). PMMA 495 A4 will be PMMA 495K MW in 4% Anisole. PMMA can be exposed by e-beam or by DUV. Processing should be done in the clean room yellow litho bay.

2. **PRE PROCESS CLEANING**

Clean your substrate using RCA (in RCA station) or Piranha (in general Acid processing bench), rinse thoroughly and dry it using the SRD (for whole wafers) or a hot plate for pieces. Additional cleaning can include rinsing in Acetone and IPA (in solvent hoods only!). Please make sure your samples are rinsed thoroughly and dried before switching between the chemistries as solvent residues can have a strong explosive reaction with Piranah.
3. **PREBAKE:**  
Prebake your substrate for at least 1 minute on a hot plate at 180 °C (inside solvent/litho hoods). Take it off the plate and let it cool to room temperature.

4. **COAT:**  
Place the substrate on the appropriate chuck in the positive resist fume hood. Chucks cannot be removed from the clean room. Use a pipet, filtered syringe or a small bottle to deposit the resist onto your substrate. Set the spin parameters (see spin curves from data sheet at the Appendix) and start the spinning process.

5. **POST BAKE:**  
Place the substrate on a hot plate set to 100°C-180°C for 60-90 seconds (parameters need to be adjusted per process).

6. **INSPECTION:**  
Inspect the sample surface (visually or using an optical microscope) for particulates or inconsistencies of the resist color. Edge differences should be expected.

7. **EXPOSE:**  
Expose the PMMA using a prepared litho mask and the DUV mask aligner or using a designed e-beam writing pattern. Please note the the DUV at 248 nm requires higher doses than 500mJ/cm² for PMMA. See the CNI shared facilities website for information about DUV MA6, DWL 66+ mask writers, Nanobeam, and Nabit writing system. If you take your sample out of the litho bay pack it so it won’t be exposed to DUV light.
8. **DEVELOP:**
To dissolve the exposed areas of the PMMA immerse your sample in the developer solution in a beaker soon after the exposure process. Typical developers are MIBK, MIBK diluted with IPA (1:1, 1:2 or 1:3) or cooled sonication in a 1:3 or 1:4 ratio of IPA:DI water. MIBK can also be diluted in DI water. The length of the immersion step varies depending on the sample and process. Rinse and dry your sample.

9. **STRIPPING or LIFTOFF:**
After processing your layer use Acetone, resist thinners or positive resist removers to liftoff your resist. Please note that using the Lift-off hood requires training by the clean room staff. Stripping the photoresist can also be done by oxygen plasma using the Anatech plasma asher or the Plasma Diener both located in the CNI clean room.
APPENDIX: SPIN CURVES (taken from PMMA data sheet on the Microchem website)

**Figure 1**
495PMMA C Resists
Solids: 2% - 6% in Chlorobenzene

**Figure 2**
495PMMA C Resists
Solids: 8% - 9% in Chlorobenzene

**Figure 3**
495PMMA A Resists
Solids: 2% - 6% in Anisole

**Figure 4**
495PMMA A Resists
Solids: 8% - 11% in Anisole

**Figure 9**
Copolymer Resists
Solids: 6% - 11% in Ethyl Lactate