

## PMMA Process Instructions

Polymethyl methacrylate (PMMA) is widely used as a positive resist (when exposed to radiation, the exposed region's chemical structure changes facilitating solubility in the developer). It is used for direct electron beam writing as well as a protective polymeric coating for wafers. PMMA can differ in its molecular weight (495K or 950K) in either anisole or chlorobenze, the former which is safer for use. Their dilutions are designated by a numerical value, i.e. PMMA 495 A4 indicates molecular weight 495K, diluted in 4 % anisole (A4) and PMMA C states dilution in chlorobenze. Different dilutions and weights have their own spin curves, the higher the dilution; the thicker the film at higher spin speeds.

**Note:** Before beginning the use of PMMA, it is imperative that you know the spin diagrams of the PMMA thickness you seek to deposit onto your wafer. Users will have their own acceleration, spin speed a spin time for their particular resist thickness. All cleaning and spinning process are done in the small or large yellow room fume hoods.

### Cleaning

- 1) Your tweezers should be cleaned before handling your Si wafers. Pre-set your hotplate for a pre-bake temperature (this will allow your hotplate to reach a constant temperature while you continue with your sample cleaning). The Si sample or substrate should be cleaned properly (organics): overnight immersion in Nanostrip, at least 45 minutes in a hot piranha solution, an RCA treatment or oxygen plasma ashing can be done to clean the surface of your substrate.
- 2) Thoroughly rinse or sonicate your substrate in both acetone and then isopropanol alcohol (IPA) solvents then dry with nitrogen gun.

### Process

The CEPSR Clean Room stores refrigerated, pre-dispensed bottles of the following PMMA resists: 495 A2, A4 and A6 as well as 950 A2, A4, and A6. When the bottle is empty, discard any residual resist into the 5 gallon resist waste container under the spinners in the large yellow room. Rinse the bottle three times with DI water. Place the rinsed bottle near the 5 gallon solvent waste container located next to the eye wash for a Clean Room staff member to pick it up for proper disposal.

- 1) Pre-bake your wafer for 1 minute on a hotplate set at 180 degrees centigrade.
- 2) After cooling to room temperature, place substrate onto spinner and set your spin parameters.
- 3) Use a pipet or filtered syringe to deposit the resist onto the wafer.
- 4) Start the spin process.
- 5) After spinning, perform a post-bake: place the wafer on a preset hotplate to 100 degrees centigrade for 60-90 seconds.
- 6) Perform a visual and or optical analysis of the wafer. Dark field analysis should show if there are any particulates or other dust particles on the surface, the color of the resist should be consistent throughout the surface of the wafer expect possibly the edges due to edge bead effects.

### **Post Exposure**

- 1)** The exposed PMMA is then developed. Typical developers are MIBK, MIBK diluted with IPA (1:1, 1:2 or 1:3) or cooled sonication in a 1:4 ratio of IPA to water. (Process variables such as choice of developer, post and pre bake times and exposure conditions should be optimized for your particular resist and device).
- 2)** To prevent scumming and to terminate the development process, quickly place the developed sample into a fresh solution of MIBK/IPA (1:3 or 1:4), alcohol or DI water. The length of immersion time is dependent on your process.
- 3)** Thoroughly dry your wafer or substrate with a nitrogen gun.
- 4)** Removal or liftoff of PMMA resist can be done with typical cleanroom solvents such as acetone, PR thinners and positive resist removers. An alternative for removal could also be PG Remover or an oxygen plasma treatment.