Negative Photoresist for EUV and Electron Beam Lithography

AQM H-SiOx

\((H_2SiO_3)_n\) Polymer

SiOx is a high purity, silsesquioxane-based semiconductor grade polymer applicable as a negative tone resist for electron beam patterns, EUV, nanoimprint lithography and Step and Flash Imprint Lithography (SFIL). It is readily soluble in non-polar organic solvents like methyl isobutylketone (MIBK), methyl siloxane and toluene for thin-film fabrication. Depending on the film thickness, a dense pattern with sub-10 nm half-pitch can be achieved.

Benefits:
- Direct write and thin uniform films
- High resolution (<10 nm features)
- Excellent line edge roughness
- Good dry etch resistance
- Customizable to meet every need
- Very long shelf live at 20°C
- Obviation of gel-like solids

Main Applications
- Photoresists for mask making and for next generation lithography (EBL, EUV, SFIL) processing.
- Mask for etching, e.g. Si, SiO2, Si3N4 or metals
- SiOx is a primary precursor to produce crystalline, sub-20 nm silicon nanoparticles
- Silicon-based photonics – waveguide components, grating couplers and photonic crystals.
- Generation of stamps with nanopatterns.

SiOx – A Leading Resist for Advanced Nanofabrication

Source: University of Alberta nanoFAB Centre
Outstanding Properties

- Performing an oxygen plasma clean, piranha bath or at dehydration bake is recommended for preparing a good surface.
- Standard spin-on deposition coating equipment.
- Hot plate exposure of 150°C can be used to remove solvent.
- Very high thermal stability: Almost no rounding of cross-linked resist patterns up to temperatures of 250°C and more.
- High chemical stability: Dependent on process parameters, SiOx is stable against many organic solvents as well as strong alkaline media.
- Suitable as etch mask exhibiting high dry and wet etch resistance.

Figure 1. Spin curves for dilute SiOx in MIBK formulations in 1%, 2%, 3% and 6% concentrations. A constant 2 sec ramp time was used in all cases and held for 40 seconds.

Resist Kits

AQM SiOx powder can be purchased separately or as resist kits containing SiOx powder, MIBK and syringes with 0.1 µm PTFE filters.

<table>
<thead>
<tr>
<th>SiOx</th>
<th>MIBK</th>
<th>w/w solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2556 g</td>
<td>5 mL</td>
<td>6%</td>
</tr>
<tr>
<td>1.024 g</td>
<td>20 mL</td>
<td>6%</td>
</tr>
<tr>
<td>0.1668 g</td>
<td>5 mL</td>
<td>4%</td>
</tr>
</tbody>
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Shelf Life and Storage - At least 1 year (stored under dry ambient conditions in the absence of light in a vacuum oven) in powder form, 3 months in MIBK solution.

“A side-by-side EBL comparison of standard HSQ and AQM SiOx (both 6% w/w in MIBK) showed that AQM SiOx can be readily used as a direct replacement for many existing EBL process flows.”

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