**Table I:** Fabrication processes used for refractive x-ray lenses and materials that are used with each fabrication process.

<table>
<thead>
<tr>
<th>Fabrication Method</th>
<th>Shape</th>
<th>Materials and Citation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilled cylindrical holes</td>
<td>1D cylinder</td>
<td>Al, Be, BN, pyrolytic graphite, PTFE, PMMA, polycarbonate,</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1D ⊥ 1D</td>
<td>(C₂H₄)ₙ³</td>
<td></td>
</tr>
<tr>
<td>Pressed 2D lenses</td>
<td>2D paraboloid</td>
<td>Al, Be, Li</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2D spherical</td>
<td>Mylar, Kapton, PMMA</td>
<td>—</td>
</tr>
<tr>
<td>Pressed 1D grooves</td>
<td>1D parabola</td>
<td>Al, Be, Ni, Fe</td>
<td>—</td>
</tr>
<tr>
<td>Bubble injection</td>
<td>2D</td>
<td>Glycerol, epoxy</td>
<td>Inside glass capillary</td>
</tr>
<tr>
<td>Immerged spheres</td>
<td>2D</td>
<td>Water</td>
<td>—</td>
</tr>
<tr>
<td>UV-light polymerization</td>
<td>2D</td>
<td>Shape-memory polymer</td>
<td>—</td>
</tr>
<tr>
<td>Photoanodic etching</td>
<td>2D parabolic pit</td>
<td>Si</td>
<td>Tiny aperture (5µm)</td>
</tr>
<tr>
<td>Lithography and dry etching</td>
<td>Planar 1D</td>
<td>Si</td>
<td>100-µm-deep possible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pcCVD C*</td>
<td>Prototypes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B, pyrolytic graphite</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planar 1D ⊥ 1D</td>
<td>Si</td>
<td>100-µm-deep interdigitated assembly</td>
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<tr>
<td>Deep x-ray lithography</td>
<td>1D ⊥ 1D</td>
<td>PMMA, PTFE</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Planar 1D</td>
<td>SU-8</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2D (1D at ± 45°)</td>
<td>PMMA, SU-8</td>
<td>Using SU-8 and PMMA photoresists</td>
</tr>
<tr>
<td>LIGA</td>
<td>Planar 1D</td>
<td>Ni</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2D (1D at ± 45°)</td>
<td>Ni</td>
<td>—</td>
</tr>
<tr>
<td>Lift-off and plasma etching</td>
<td>Planar 1D</td>
<td>pc C*</td>
<td>—</td>
</tr>
<tr>
<td>Atomic layer deposition</td>
<td>Planar 1D</td>
<td>Al₂O₃</td>
<td>Constant width lamella</td>
</tr>
<tr>
<td>Si mold, electroplating and polymer</td>
<td>Planar 1D</td>
<td>Polyethylene</td>
<td>1D Si structure inverted by Ni plating, serving as mold</td>
</tr>
<tr>
<td>injection molding</td>
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<td></td>
<td></td>
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<tr>
<td>CVD deposition into prefabricated</td>
<td>Planar 1D</td>
<td>Nano- and microcrystalline C*</td>
<td>—</td>
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<tr>
<td>Si molds</td>
<td>1D cutting</td>
<td>Glassy carbon, scCVD C*, ccCVD C*</td>
<td>Pico- and femtosecond systems</td>
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<tr>
<td></td>
<td>1D shaping</td>
<td>scHPHT C*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2D shaping</td>
<td>scHPHT C*, scCVD C*</td>
<td></td>
</tr>
</tbody>
</table>

Note: PMMA (also named Plexiglas, Acrylite, Lucite) is a transparent thermoplastic and a positive photoresist; SU-8 is an epoxy-based negative photoresist; quartz glass (SiO₂) is amorphous and has a density similar to Si.