General Product Description
Heraeus chemist Richard Küch first began fusing quartz rock crystal in an hydrogen/oxygen flame more than 100 years ago. Heraeus has been producing quartz glass on an industrial scale with this process ever since.

Flame fused quartz contains a significant amount of hydroxyl (OH) as a result of the direct contact between the H2/O2-flame and quartz grain. This OH content cannot be reduced by annealing and its presence lowers viscosity and infrared transmission. However, the fact that the fusion atmosphere is oxidizing has a favorable effect on the diffusion of heavy metal impurities even though the amount of such contaminants present is very small. In particular, the ability of iron to migrate out of the quartz glass seems to be inhibited by the oxidizing conditions. This can have desirable effects for semiconductor manufacturing or other processes where a high sensitivity to heavy metals exists.

In addition, flame fused quartz is free of larger bubbles.

Process
The basic process consists of trickling high purity quartz sand at a controlled rate into a hydrogen / oxygen flame. There it melts and collects on a bait rod that is slowly withdrawn from the flame thus forming a solid round ingot (see picture above) that can be further shaped into any dimension.

Product Range
Heraeus Quarzglas offers two varieties of flame fused material: HSQ 351 and HSQ 751. Which material is best depends on the thermal properties and chemical purity required, which in turn depend on the final application.

HSQ 351 offers exceptional material purity good for most semiconductor applications. However HSQ 751 offers significantly lower aluminum, alkali and heavy metal impurities for more demanding applications. Both are available as rods, tubes, plates, ingots, flanges and blocks.

Chemical Purity
Typical Trace Elements and OH Content in Flame Fused Quartz Glass (ppm by weight oxide)

<table>
<thead>
<tr>
<th>Elements</th>
<th>Al</th>
<th>Ca</th>
<th>Cr</th>
<th>Cu</th>
<th>Fe</th>
<th>K</th>
<th>Mg</th>
<th>Mn</th>
<th>Na</th>
<th>Ti</th>
<th>Zr</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSQ 351</td>
<td>15</td>
<td>0.6</td>
<td>&lt;0.05</td>
<td>0.07</td>
<td>0.2</td>
<td>0.7</td>
<td>0.4</td>
<td>0.1</td>
<td>0.05</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>HSQ 751</td>
<td>8</td>
<td>0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.06</td>
<td>0.2</td>
<td>&lt;0.1</td>
<td>0.2</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>1.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

OH Content 175

Thermal process data:
1200°C, 120 min, N2 = 8SLM

Quartz glass used for thermal processing can influence silicon wafers. Studies involving wafers in direct contact with quartz glass gave the following results:

bulk results:
• Significant lifetime degradation and lateral influence from electrically fused samples
• Low influence from HSQ 351 and HSQ 751
• Results showed greatly reduced heavy metal content in silicon wafer using HSQ 351 / HSQ 751 instead of electrically fused quartz.

Surface results:
• Significant influence (photo current reduction) from electrically fused material
• Low influence from HSQ 351 and HSQ 751 samples.

(1) Metal Contamination in ULSI Technology
(2) Imaging of Heavy Metal Contamination in Silicon Wafers for the Evaluation of Process Tools.
P. Eichinger, GerMetc, STEP Europe Conference on Ultraclean Processing, Brussels, Oct. 90, p. 122