Quartz glass products are indispensable within the semiconductor production process. Together with the increase in integration rates in semiconductor devices, from IC to LSI to ultra-LSI, there is an even stronger demand for quartz glass of higher purity and precision. Now, as we enter the era of the 300 mm wafer, progress is being made on larger scale quartz tools and equipment, as more advanced nature of quartz glass comes into demand. Since its founding, Shin-Etsu Quartz Products Co., Ltd. (SQP) has been developing products that fulfill the most advanced needs and demands of the semiconductor industry. Products are produced and marketed after being made using the Company's exceptional processing.
"Shin-Etsu Quartz": a "Quartz" supplier always in pursuit of "Shin"-rai (reliability) and taku-"Etsu" (excellence).

The Trust Fostered by a Global Top-Share

SQP, as a part of the Heraeus Group, supplies quartz glass products to major semiconductor regions worldwide. In each of these regions, the group harbors a top market share along with top manufacturing capabilities. This is truly a proof of the trust the group has garnered by continuously providing stable and reliable global support to its customers. With its wide variation of products from natural to synthetic to opaque quartz, to its special application products, SQP is able to consistently meet the diverse needs of its users.

Quartz Business: Expanding from Japan to Rest of Asia

SQP, with its territorial base in Japan, has a good balance of 2 raw material plants and 3 fabrication plants inside Japan. Sales offices have been strategically placed in 6 locations nationwide in order to provide customers with fast and thorough care and service. SQP has also developed a stable supply network to the two emerging semiconductor and LCD production magnates, Taiwan and Korea, as well as China, the market's hope for the 21st Century, and serves as the business center for the expanding Asian market.

Reliably Accomodating Products for the Emerging 300mm Wafer Process

300mm wafers usage has started in semiconductor production and from the beginning, SQP has pioneered the quartz products designed for 300mm semiconductor equipments. By combining technologies it has cultivated thus far, SQP succeeded in becoming one of the first to commercialize large diameter quartz glass parts essential for 300mm equipments. Already the Company has a proven record of sales in both domestic and overseas markets and is moving forward with even more innovations and increased capabilities to prepare for the full realization of the 300 mm wafer process.

Fully Integrated Production: from Raw Materials to Finished Products.

SQP imports base material quartz glass from its parent company, Heraeus Quarzglas GmbH & Co.KG. The imported material is first processed into raw materials which is then utilized to build the quartz products for various applications. With this fully integrated manufacturing, SQP is able to maintain stability in terms of both quality and supply. The technical advancement and innovations within each manufacturing process is a key link to the total quality advancement of our products. If necessary, all products can be completely traced from the end product all the way up to the starting base material.

- Production Flow Chart from Raw Materials to Processed Goods
Quartz Glass for Semiconductor and LCD Production Process

For transparent quartz, SQP offers everything from standard products to ultra-high purity synthetic quartz, as well as specially processed goods with improved functionality, such as improved heat-resistance and plasma-resistance properties, and reduced particle generation. Its full line-up of materials enables SQP to meet the needs and requirements of all of its customers.

· Product Types

<table>
<thead>
<tr>
<th>Category</th>
<th>Grade</th>
<th>Characteristics</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Quartz Glass</td>
<td>Flame Fused Quartz</td>
<td>Products for standard applications. These are widely used in semiconductor production processes.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td></td>
<td>HERALUX</td>
<td>High-purity product, especially low in alkali metals. The metallic impurities have been removed using a unique refining method.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td></td>
<td>HERALUX-LA</td>
<td>Product with high heat-resistance properties. Low in OH content, it is suited for use in high-temperature processes.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td>Electric Fused Quartz</td>
<td>HERALUX-E</td>
<td>Has high purity along with heat-resistance properties. A special refining treatment has been performed to remove metallic impurities (especially alkali metals).</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td></td>
<td>HERALUX-E-LA</td>
<td>Cost performance material with high purity and high heat resistance sustained.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td>Opaque Quartz</td>
<td>SO-210</td>
<td>Opaque quartz with large amounts of microscopic bubbles.</td>
<td>Plate</td>
</tr>
<tr>
<td></td>
<td>OM-100</td>
<td>High-purity Opaque quartz manufactured with Company-unique technology. Its special microstructure gives it a high density and high thermal-insulation</td>
<td>Molding Press</td>
</tr>
</tbody>
</table>

Synthetic Quartz Glass

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH110</td>
<td>Synthetic quartz glass with all unnecessary impurity elements and bubbles, etc., removed. This product is widely used in standard applications.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td>SH100</td>
<td>Synthetic quartz glass with higher heat-resistance than conventional synthetic quartz, especially through its reduced OH content.</td>
<td>Tube, Rod, Plate</td>
</tr>
<tr>
<td>SH200</td>
<td>Although this has a high OH content (approximately 800 ppm), this product has superior homogeneity.</td>
<td>Plate</td>
</tr>
</tbody>
</table>

*Please note that in addition to the above-described products, for both flame fused and electrically fused products, we also offer St treated products with improved heat-resistance and stability characteristics. Please refer to the next page for St treatment.

Flame Fused Products
With this method, an oxyhydrogen flame is used to melt natural quartz glass powder to form quartz glass. Since the reaction of oxygen and hydrogen is used, the melted quartz glass generally contains OH.

Electrically Fused Products
With this method, electricity is used to fuse natural quartz glass. Since no water is generated, the produced quartz glass contains almost no OH.

Synthetic Quartz Products
Compared with natural products, synthetic quartz products are characterized by their extremely low amounts of metallic impurities and also their high homogeneity. Shin-Etsu Quartz offers three varieties of synthetic quartz glass types, using flame hydrolysis to control the OH content.

<table>
<thead>
<tr>
<th>Grade</th>
<th>OH contents</th>
<th>Viscosity(logh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HERALUX</td>
<td>0.2</td>
<td>12.0</td>
</tr>
<tr>
<td>HERALUX-LA</td>
<td>0.3</td>
<td>12.0</td>
</tr>
<tr>
<td>HERALUX-E</td>
<td>0.05</td>
<td>12.0</td>
</tr>
<tr>
<td>HERALUX-E-LA</td>
<td>0.05</td>
<td>12.0</td>
</tr>
<tr>
<td>HSQL330</td>
<td>0.1</td>
<td>12.0</td>
</tr>
<tr>
<td>SO-210</td>
<td>0.4</td>
<td>12.0</td>
</tr>
<tr>
<td>OM-100</td>
<td>0.2</td>
<td>12.0</td>
</tr>
<tr>
<td>SH110</td>
<td>0.01</td>
<td>12.0</td>
</tr>
<tr>
<td>SH100</td>
<td>0.01</td>
<td>12.0</td>
</tr>
<tr>
<td>SH200</td>
<td>0.01</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Note: Values shown in this chart are not standard (i.e., guaranteed) values.
Special Processing Technologies for Improving Functional Characteristics

The addition of special processing within our materials production processes and working processes enables us to offer materials and products with improved functional characteristics.

**SST (Special Surface Treatment)**

The SST process is a revolutionary method for texturized surface on the quartz glass surface via chemical treatment. The texturized surface has the effects of easing the differences in the respective thermal expansion coefficients of the deposited film and the quartz glass. When used in the CVD process, this makes it harder for microcracks to form on the quartz surface. Not only is this linked to longer product life, but it also means major reductions in particle generation.

Here is a nitride film (film thickness: 10 nm) formed on quartz glass treated with the SST process. No microcracks have been formed.

**St Treatment (Tubes)**

In the diffusion process for semiconductor manufacturing, processing is generally performed at high temperatures. Thus, the quartz glass tubes used for the furnace tube must have a high heat-resistance. The St treatment is a heat stabilization treatment technology that improves the heat-resistance properties of quartz glass tubes. This "stabilization treatment" is the formation of a crystalline layer on the external surfaces of glass tubes by means of a uniform thin doping of nucleus forming element, Al. Compared with non-treated elements, glass tubes that have undergone this stabilization treatment can be used longer and are not easily deformed; thus the end effects are an increase in the product life of treated tubes. The St treatment can be used applied to both flame fused quartz products and electric fused quartz products.

**Fluorocarbon Polymer (PFA) Coating**

With this coating technology, a fluorocarbon polymer (PFA) is coated onto the surface of quartz glass products. PFA coated quartz glass equipment, such as carrier boats used in Si wafer cleaning; prevents particle generation during the cleaning process, reduces scratching of quartz glass and Si wafers, and also helps to prevent chipping of wafer edges. Also, because the fluorocarbon polymer used for the coating is of an extremely high purity, there is no worry about contamination of Si wafers, thereby enabling processes to be performed at the same cleanliness levels as with a non-coated boat. PFA coated quartz glass carrier boats can also be used, just as conventional products, within IPA dryers.

In addition to PFA coating, we also perform Polyimide coating for various applications.
Quartz Glass Fabricated Goods

Furnace Tubes and Boats
For furnace tubes and boats, used commonly in oxidation, diffusion, and CVD processes, high-purity and high heat-resistance properties are required. Especially, as vertical-type furnaces have become the mainstream, there has been a stronger demand for higher quality of quartz glass products. As 300 mm wafer size applications comes into utilization, and as single-wafer processing expands, quartz glass products of a much larger scale will be in need.

Parts for Etching and Ashing Processes
For dry etching, plasma CVD, and ashing processes, single-wafer processing is widely used. These processes require many quartz glass parts in many various size and shapes, including chambers, rings, plates. These products are all manufactured utilizing the technologies cultivated by SQP over many long years. Meanwhile, the Company continues to vigorously pursue and develop new technologies and products. One such example is the development of the quartz glass with excellent plasma etching resistance properties.

Fabricated Parts for Wet Cleaning
Within the semiconductor manufacturing process, there are cleaning processes that uses large amounts of cleaning chemicals, as well as ultra-pure water. The tools and equipment used in these processes, including cleaning utensils, are largely made of quartz glass parts as a means of preventing contamination. SQP makes products for wet cleaning in many variety of shapes, according to the needs of our customers. At the same time, the Company has continued to offer new technologies for raising productivity and efficiency of our users, such as the use of fluorocarbon polymer coating.

Other Fabricated Goods
The use of quartz glass processed goods is not limited to semiconductor and LCD production applications. Preforms used for making quartz-glass optical fiber uses quartz burners and other quartz made parts. Also, many quartz glass products are used in scientific equipments used at universities and research facilities. In fact, quartz glass products are used in so many different kinds of industrial fields, from chemistry and pharmaceuticals-related fields to food products. All of these various products are manufactured to the specified requirements of our customers.

ROTOPSIL (opaque quartz glass) from Heraeus
Opaque quartz glass is used in the chemicals industry, high-temperature processes, in electrical facilities and equipment, and so on. A variety of shapes are offered in accordance with the application; shapes include belljars, tubes, crucibles, etc. SQP uses the ROTOPIR brand of opaque quartz glass of the Heraeus Group.
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