Purity is critical to high wafer yield, and Kalrez® seals are designed with properties that help reduce contamination from particulates, outgassing and extractables.

**Semiconductor Processing Seals**

Kalrez® seals for semiconductor processing are field-proven in the manufacture of semiconductor chips.

They can help extend planned maintenance intervals, and thereby lower long-term cost of ownership, in a wide range of semiconductor processes. In a number of fabrication customer evaluations, Kalrez® seals exhibited improved mechanical strength, lower particle generation and longer seal life versus competitive perfluoroelastomers, in both static and dynamic sealing applications.

**Operational Improvements**

Kalrez® seals can help improve semiconductor manufacturing in a range of wafer-fabricating operations, including:

- Deposition
- Etch
- Ash/strip
- Thermal
- Wet

**Better Performance for Spansion**

Spansion, the largest provider of flash memory solutions, turned to DuPont for material options that would produce longer seal life with reduced particle generation. High particle count and leaks from seal erosion and compression set caused seal issues in multiple processes. Kalrez® 9100 parts exhibited significantly less seal erosion, reduced particle generation, and provided better elastic recovery characteristics.
Spansion, Inc. Case Study

The Challenge

In the very competitive environment of semiconductor chip manufacturing, reduced cost per wafer is a top priority. DuPont successfully collaborated with Spansion Inc. Fab 25 in Austin, Texas to evaluate an O-ring product designed to help increase the uptime of HDPCVD equipment operating under aggressive chamber cleaning plasma conditions.

The dramatic improvement in seal performance enabled Spansion to make a step change in their preventative maintenance (PM) schedule that resulted in increased productivity and reduced cost-of-ownership. Spansion is the largest provider of Flash memory solutions in the world for the integrated electronics market.

The Solution

For Roger Sorum, equipment engineer at Spansion Fab 25, uptime and quality are his primary responsibilities to help maintain a competitive advantage. A problem occurred in the HDPCVD equipment when process gases (SiH4, O2, He) and chamber cleaning plasma (two stage NF3 and O2 plasma) created an aggressive process environment. High particle count and leaks from seal erosion and compression set caused sealing issues in IMD and STI processes. The scheduled PM cycle was 90 days, but premature sealing issues occurred within 30–60 days with the isolation valve poppet seal, slit valve door seal and the MESC port flange insert seal. The incumbent O-ring performance issues were related to physical as well as chemical plasma attack creating seal erosion.

Replacing O-rings can take up to 12 hours to bring the machine back on line and pass wafer qualification. Some seal locations limit individual chamber production, while others limit the entire tool. “The challenge is to increase availability while reducing the total cost-of-ownership” says Sorum.

Spansion turned to DuPont for options to produce longer seal life with reduced particle generation. Within several months, DuPont developed a prototype.

After reviewing test results, parts were produced for trials against other competitive FFKM products. Kalrez® 9100 parts outperformed the competitive FFKM products under all conditions. The DuPont and Spansion team, working together, pushed Kalrez® 9100 parts to extreme parameters faster than anyone expected and contributed to the success of this process.
Key Advantages

Key learnings from the collaboration were the following:

1. Active feedback during development in real time;
2. Testing Kalrez® 9100 parts in the harshest possible conditions;
3. Extending testing well beyond timeframes for planned maintenance to establish a new, far-reaching standard for PM limits, all with Spansion process engineering agreement. Currently, Kalrez® 9100 continues to exceed the normal Spansion PM schedule by up to 6 times longer, extending the 30-day PM out to 180 days, depending upon the seal location. Increased equipment availability has increased the fab production capacity by more than 20%, without the need to purchase and install additional equipment. Spansion has now expanded their adoption of Kalrez® 9100 to other tools in both thin films and dry etch with consistently favorable results.

### Kalrez® 9100 Comparison Chart

<table>
<thead>
<tr>
<th>SEAL DESCRIPTION</th>
<th>SEAL SIZE</th>
<th>SEAL LIFE</th>
<th>SEAL PERFORMANCE</th>
<th>SEAL LIFE</th>
<th>SEAL PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO POPPET VALVE</td>
<td>222</td>
<td>&gt;360 days</td>
<td>No Signs of Erosion</td>
<td>&lt;30 days</td>
<td>Heavy Erosion, Shredding/Leaks</td>
</tr>
<tr>
<td>MESC FLANGE INSERT</td>
<td>167-R custom</td>
<td>&gt;180 days</td>
<td>No Signs of Erosion</td>
<td>&lt;60 days</td>
<td>Heavy Erosion/Leaks</td>
</tr>
<tr>
<td>SLIT VALVE DOOR</td>
<td>263</td>
<td>&gt;180 days</td>
<td>Slight Erosion and Compression Set</td>
<td>&lt;90 days</td>
<td>Heavy Erosion, Compression Set/Particles, Leaks</td>
</tr>
<tr>
<td>GAS MANIFOLD INNER</td>
<td>383</td>
<td>&gt;270 days</td>
<td>No Signs of Erosion, Slight Compression Set</td>
<td>&lt;90 days</td>
<td>Heavy Erosion, Compression Set/Particles, Leaks</td>
</tr>
<tr>
<td>GAS MANIFOLD OUTER</td>
<td>384</td>
<td>&gt;270 days</td>
<td>No Signs of Erosion</td>
<td>&lt;90 days</td>
<td>Erosion, Compression Set/Leaks</td>
</tr>
<tr>
<td>DOME LID</td>
<td>383</td>
<td>&gt;360 days</td>
<td>No Signs of Erosion</td>
<td>&lt;180 days</td>
<td>Erosion, Compression Set/Leaks</td>
</tr>
<tr>
<td>TURBO GATES (INCUMBENT FLUORO-ELASTOMER)</td>
<td>372</td>
<td>&gt;360 days</td>
<td>No Signs of Erosion</td>
<td>&lt;180 days</td>
<td>Some Erosion, Shredding, Set/Leaks</td>
</tr>
</tbody>
</table>

### Key Advantages

- Active feedback during development in real time;
- Testing Kalrez® 9100 parts in the harshest possible conditions;
- Extending testing well beyond timeframes for planned maintenance to establish a new, far-reaching standard for PM limits, all with Spansion process engineering agreement. Currently, Kalrez® 9100 continues to exceed the normal Spansion PM schedule by up to 6 times longer, extending the 30-day PM out to 180 days, depending upon the seal location. Increased equipment availability has increased the fab production capacity by more than 20%, without the need to purchase and install additional equipment. Spansion has now expanded their adoption of Kalrez® 9100 to other tools in both thin films and dry etch with consistently favorable results.
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