

# DuPont™ Kalrez® 9100

For Semiconductor Applications

Technical Information—Rev. 7, July 2010

## Product Description

DuPont™ Kalrez® 9100 perfluoroelastomer parts are an amber translucent product targeted specifically for etching and deposition process applications, e.g., HDPCVD, PECVD and ALD. It has also exhibited excellent performance in "select" ashing/stripping processes. Kalrez® 9100 has been specifically designed for low erosion and ultra-low particle generation in harsh plasma environments. It offers excellent thermal stability, very low outgassing as well as excellent elastic recovery and mechanical strength properties and is well suited for both static and dynamic sealing applications. A maximum continuous service temperature of 300 °C is suggested. Ultrapure post-cleaning and packaging is standard for all Kalrez® 9100 parts.



## Features/Benefits

- Low erosion rate and ultra-low particle generation in oxygen and fluorine-based plasmas
- Excellent resistance to dry process chemistry
- Excellent thermal stability
- Very low outgassing properties and metals content
- Excellent elastic recovery and low compression set properties

## Suggested Applications

- Gas inlet/orifice seals
- Chamber lid seals
- Isolation valve seals
- Bonded gate valves/slit valve door seals

## Typical Physical Properties<sup>1</sup>

Color	Amber Translucent
Hardness, Shore A (Plied Slab) <sup>2</sup>	68
Hardness, Shore M (O-ring) <sup>3</sup>	74
100% Modulus <sup>4</sup> , MPa	4.27
Tensile Strength at Break <sup>4</sup> , MPa	11.85
Elongation at Break <sup>4</sup> , %	220
Compression Set <sup>5</sup> , %	
70 hr at 204 °C	17
70 hr at 250 °C	21
70 hr at 300 °C	53
Maximum Continuous Service, Temperature <sup>6</sup> , °C	300

<sup>1</sup> Not to be used for specification purposes

<sup>2</sup> ASTM D2240 (plied slab test specimens)

<sup>3</sup> ASTM D2240 & D1414 (AS568 K214 O-ring test specimens)

<sup>4</sup> ASTM D412 & D1414 (AS568 K214 O-ring test specimens)

<sup>5</sup> ASTM D395B & D1414 (AS568 K214 O-ring test specimens)

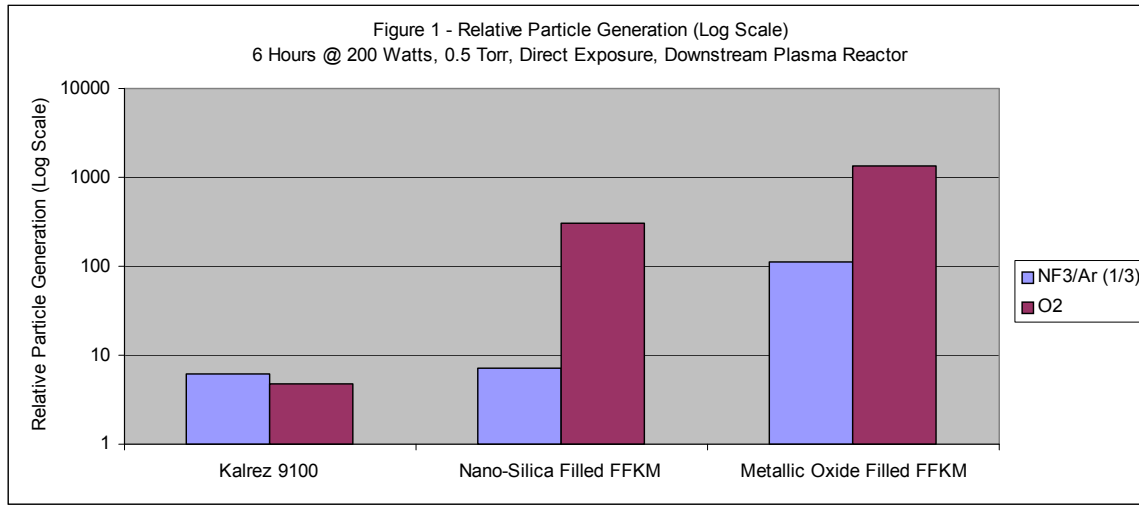
<sup>6</sup> DuPont proprietary test method



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## Particle Generation

Conventional perfluoroelastomer (FFKM) sealing materials normally contain carbon black and/or mineral fillers. Newer products are either unfilled or formulated with polymeric fillers. Plasma resistance can be significantly different depending on the type of filler used. If the filler has high resistance to plasma, such as BaSO<sub>4</sub>, TiO<sub>2</sub>, etc., it can “shield” the polymer to reduce erosion or weight loss, but have the high potential for particle generation by leaving discrete particles behind once the polymer has become etched. Unfilled and polymeric filled products essentially contain no other elements other than carbon, fluorine and oxygen, which can be completely etched to form volatiles, thereby significantly reducing the potential for contamination. Figure 1 shows the relative particle generation of DuPont™ Kalrez® 9100 versus a nano-silica and a metallic oxide filled FFKM product in different plasmas.



## Fabs Choose Kalrez® 9100 For Improved Performance

Kalrez® 9100 has been reported to significantly improve wafer production in a variety of semiconductor process applications, i.e., HDPCVD, PECVD, etching, ashing, etc., where oxygen and fluorinated plasmas are used during the cleaning cycle. In a number of evaluations at fab line customers, Kalrez® 9100 exhibited less erosion, lower particle generation and longer seal life compared to competitive perfluoroelastomers in both static and dynamic sealing applications.

### Case Report #5903 — PM Cycle Extended 3X! at Major US Fab Line

- Fab line has extended PM cycle from 60 to 180 days
- No evidence of erosion, leakage, mechanical damage or compression set after 180 days of service
- Equipment Platform — Novellus® Concept Two SPEED®
- Process — HDPCVD / STI
- Process Chemistry — SiH<sub>4</sub>, He, O<sub>2</sub>
- Cleaning Chemistry — NF<sub>3</sub> plasma at 4000 watts
- Seal Locations — slit valve door, inner gas manifold ring, MESC flange insert, Iso-poppet valve, turbo gate, dome lid

### Case Report #6376 — PM Cycle Improved 2X! at Major European Fab Line

- Fab line has extended PM cycle from 30,000 to >55,000 pairs of wafers
- No evidence of erosion, mechanical damage, compression set or deformation of the seal lip
- Equipment Platform — Applied Materials® Producer® Low-k
- Process — PECVD / Black Diamond®
- Process Chemistry — Trimethyl silane (TMS), O<sub>2</sub>
- Cleaning Chemistry — NF<sub>3</sub> plasma via remote plasma source
- Seal Location — VAT MONOVAT® bonded door

**Case Report #6441 — PM Target Exceeded at Major European Research Center**

- No/minimal evidence of erosion or degradation after processing 5,000 wafers (Figure 2)
- Research center is currently conducting testing to determine maximum practical seal life
- Equipment Platform — Applied Materials® Centura® Ultima®
- Process — HDPCVD / STI
- Process Chemistry — SiH<sub>4</sub>, He, O<sub>2</sub>,
- Cleaning Chemistry — NF<sub>3</sub> plasma at 3000 watts
- Seal Location — roughing isolation valve poppet seal, top nozzle assembly o-ring seal

Figure 2. DuPont™ Kalrez® 9100 and incumbent seals after processing 5000 wafers. It was the research center's opinion that the Kalrez® 9100 seals could have continued to function beyond the scheduled PM cycle of 5,000 wafers.



Kalrez® 9100 Poppet Seal



Incumbent FFKM Poppet Seal



Kalrez® 9100 Top Nozzle Seal



Incumbent FFKM Top Nozzle Seal

**Case Report #6738 — PM Cycle Extended 3X! at Major US Fab Line**

- Fab line has extended PM cycle from 400 to 1200 Rf hours
- No evidence of degradation or cracking after 1200 Rf hours of service
- Equipment Platform — Lam Research TCP-9600
- Process — Metal Etch and Resist Strip/Ash
- Process Chemistry — Cl<sub>2</sub>, BCl<sub>3</sub>, Water Vapor
- Cleaning Chemistry — O<sub>2</sub> plasma (cleans ash deposits after every wafer)
- Seal Location — custom seal for slit valve opening

**Case Report #6302 — PM Cycle Extended 3X! at Major US Fab Line**

- Fab line has extended PM cycle from 6,000 to 18,000 wafers
- No evidence of erosion, cracking or compression set after processing 18,000 wafers
- Equipment Platform — Tokyo Electron SCCM Etch Chamber
- Process — Oxide Etch and Dual Damascene Copper
- Process Chemistry — C<sub>4</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>6</sub>, C<sub>5</sub>F<sub>8</sub>, O<sub>2</sub>, Ar
- Cleaning Chemistry — CF<sub>4</sub> and O<sub>2</sub> plasma
- Seal Location — pendulum valve seal kit

## Case Report #5415 — PM Cycle Extended 3X! at Major US Fab Line

- Fab line has extended PM cycle from 6 to 18 months
- No evidence of erosion, cracking or leakage after 18 months of service
- Equipment Platform — Mattson Aspen II (Grid Shielded System)
- Process — ICP (Ashing)
- Process Chemistry — CF<sub>4</sub>, O<sub>2</sub>, Forming Gas
- Cleaning Chemistry — N/A
- Seal Location — quartz tube

*Note:* Color variations may be observed in DuPont™ Kalrez® 9100 parts. Variations are considered to be cosmetic. See below for additional details. Please contact a Kalrez® Area Sales Manager or a Kalrez® Applications Engineer if you have any questions or if you need any additional information.

### Marks (Dark Spots)

Small marks (dark spots) may be present in Kalrez® 9100 parts. The mark (dark spot) is a result of the curing process and is inherent in the part. It is not indicative of foreign matter and is not expected to have an adverse effect on the performance of the part in service.

### Darker Sealing Element — Bonded Door Seal (BDS)

The color of the sealing element in a Kalrez® 9100 bonded door seal (BDS) is darker than a Kalrez® 9100 O-ring for two reasons. First, Kalrez® 9100 BDS are manufactured at different standard operating conditions versus Kalrez® 9100 O-rings. Second, since the sealing element is bonded to the aluminum on at least one or more sides, less light passes through it. In both cases, this is a color issue, i.e., the darker color is not indicative of foreign material present in the sealing element nor is it expected to have an adverse effect on the performance of Kalrez® 9100 BDS in service.

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