DuPont™ Kalrez®

Perfluoroelastomer Parts

For Photovoltaic Manufacturing Processes

Technical Information — September 2012

Increase Uptime…

Increase Throughput…

Lower Cost of Ownership…

As the demand for photovoltaic systems continues to rise, manufacturers must find ways to increase uptime and improve output. Frequently, more aggressive and efficient chemicals, and/or higher temperatures are employed to increase throughput; thereby, putting more strain on the manufacturing infrastructure. Unplanned maintenance due to incompatible sealing materials can interfere with production schedules causing downtime. As a result, sealing materials in either wafer-based or thin film processes should have broad chemical compatibility and excellent thermal stability.

DuPont™ Kalrez® perfluoroelastomer parts have been field proven in highly aggressive sealing environments for more than 30 years. Kalrez® parts can help improve sealing reliability in photovoltaic processes that use high heat, aggressive chemicals and plasma. Kalrez® seals resist over 1,800 chemicals including reactive gases and plasmas, alkalis, acids and solvents. Even in contact with these corrosive chemicals, Kalrez® seals retain their elastomeric properties at temperatures as high as 325 °C.

The latest sealing product from DuPont to provide optimal performance, Kalrez® W230 perfluoroelastomer parts are the choice in PV wet and select dry processes as an upgrade from standard elastomers. W230 provides an excellent combination of properties (resistance to acids/bases), along with the proven performance expected from DuPont™ Kalrez® perfluoroelastomers parts.

On page 2 are the suggested Kalrez® products for use in the different photovoltaic cell manufacturing processes and for poly-silicon feedstock production and abatement systems.

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Photovoltaic Product Selector Guide

Silicon wafer-based cell manufacturing processes

Surface Texturing/Cleaning	Doping	Edge Isolation	P Silicate Removal	ARC Coating	Metallization	Testing Sorting
Kalrez® W230	Kalrez® PV8070	Kalrez® W230/9100	Kalrez® W230	Kalrez® W230/ 9100		

Process Type	Typical Process Environment	Suggested DuPont Product
Wafer Sawing Damage Removal Surface Texturing and Cleaning	HF, HNO_3, 80 °C Concentrated NaOH, KOH, IPA, HCl, Hot Water	Kalrez® W230
N-Doping	850–900 °C, $POCl_3$, Diffusion, In-Situ Cl_2 Cleaning	Kalrez® PV8070
Edge Isolation	CF_4/O_2 Plasma Etching	Kalrez® W230/9100*
P Silicate Removal	NaOH, KOH, HF, HNO_3, HCl, etc.	Kalrez® W230
ARC Coating	SiH_4, NH_3, O_2 Plasma PECVD or Reactive Sputtering, In-Situ NF_3 Plasma Cleaning	Kalrez® W230/9100*
Other Process Types	**Typical Process Environment**	**Suggested DuPont Product**
Poly-Silicon Feedstock Production Siemens Technology	TCS CVD Deposition 1100°C, $SiHCl_3$, HCl, H_2	Kalrez® W230/PV8070*
Abatement Systems (“Wet” Scrubbers)	Strong Acids/Bases	Kalrez® W230

Thin film cell manufacturing processes

Back Contact	Patterning Laser Scribing	Cell Layer Deposition See Below For Product	Patterning Laser Scribing	TCO Deposition See Below For Product	Patterning Laser Scribing	Testing Sorting

Process Type	Typical Process Environment	Suggested DuPont Product
Cell Layer Deposition/Absorber		
• Amorphous/Micro-Crystalline Silicon	SiH_4, H_2, Plasma PECVD, Remote NF_3 Plasma Cleaning	Kalrez® W230/9100*
• CIS/CIGS		
○ Diffusion	500–550 °C, H_2Se, H_2S Diffusion	Kalrez® W230/PV8070*
○ CdS Buffer Deposition	65 °C, Cd & S Salts Dissolved in NH_4OH	Kalrez® W230
○ Cu (In, GA) Sputtering	400-600 °C, Vacuum	Kalrez® W230
• Cadmium Telluride		
○ Single Side Activation	400 °C, $CdCl_2$ Dissolved in Methanol,	Kalrez® W230
○ Cadmium Etching	Concentrated H_3PO4, HNO_3	Kalrez® W230
○ CdS Buffer Deposition	65 °C, Cd & S Salts Dissolved in NH_4OH	Kalrez® W230
TCO Deposition/Front Contact	ZnO Reactive Sputtering	Kalrez® W230
	Diethyl Zinc (DEZ) MOCVD	Kalrez® W230/PV8070*

***Contact a Kalrez® Application Engineer for the most appropriate product in this application**

Suggested Products for Photovoltaic Use

DuPont™ Kalrez® W230

Kalrez® W230 perfluoroelastomer parts are a black product for PV wet and select dry manufacturing processes requiring a wide range of chemical resistance. W230 provides an excellent combination of properties (resistance to acids/bases) and is the product of choice for PV wet processes as an upgrade from standard elastomers. A maximum continuous service temperature of 230 °C is suggested.

DuPont™ Kalrez® PV8070

Kalrez® PV8070 perfluoroelastomer parts are a black product for PV cell manufacturing processes requiring high temperature resistance. It exhibits outstanding thermal stability and has excellent (low) compression set and outgassing properties. It also offers excellent resistance to chlorine and fluorine gas as well as other dry process chemistry. Kalrez® PV8070 has excellent mechanical strength properties and is well suited for both static and dynamic sealing applications. A maximum continuous service temperature of 325 °C is suggested. Short-term excursions to higher temperatures may also be possible.

DuPont™ Kalrez® 9100

Kalrez® 9100 perfluoroelastomer parts are an amber translucent product for edge isolation, ARC coating and PV cell manufacturing processes requiring resistance to fluorine-based plasma including amorphous/microcrystalline silicon thin film deposition. It exhibits very low weight loss and ultra-low particle generation in fluorine-based plasma, e.g., NF_3, F_2, etc. It also offers excellent resistance to dry process chemistry and has excellent thermal stability, compression set and outgassing properties. Kalrez® 9100 has good mechanical strength properties and is well suited for both static and dynamic sealing applications. A maximum continuous service temperature of 300 °C is suggested.

Typical Physical Properties[1]

Product	Color	Hardness[2] Shore M (O-ring)	100% Modulus[3], MPa	Maximum Continuous Service Temperature[5], °C	Compression Set, 70 hrs. at 204 °C[6], %
Kalrez® W230	Black	82	7.66[4]	230	21
Kalrez® PV8070	Black	83	12.21	325	14
Kalrez® 9100	Amber Translucent	74	4.76	300	17

[1] Not to be used for specification purposes

[2] ASTM D2240 and D1414 (AS568 K214 O-ring test specimens)

[3] ASTM D412 (Dumbbell test specimens) unless otherwise specified

[4] ASTM D412 and D1414 (AS568 K214 O-ring test specimens)

[5] DuPont Performance Polymers proprietary test method

[6] ASTM D395B and D1414 (AS568 K214 O-ring test specimens)

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