DuPont™ Kalrez® and Zalak®
For Photovoltaic Manufacturing Processes

Technical Information — Rev. 6, July 2010

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, Zalak® 5300 high performance seals, join the Kalrez® perfluoroelastomer product line as a cost-effective alternative in select applications where traditional sealing materials are insufficient. It bridges the performance gap between standard fluoroelastomers (FKM) and perfluoroelastomers (FFKM) parts. Zalak® 5300 parts have been specially formulated for use in the different photovoltaic manufacturing processes.

On page 2 are the suggested Kalrez® or Zalak® 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® PV8030	Kalrez® PV8070/ PV8050	Zalak® 5300	Kalrez® PV8030	Zalak® 5300 / Kalrez® PV8050	Kalrez® PV8070	

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® PV8030
N-Doping	850–900 °C, $POCl_3$, Diffusion, In-Situ Cl_2 Cleaning	Kalrez® PV8070/PV8050
Edge Isolation	CF_4/O_2 Plasma Etching	Zalak® 5300
P Silicate Removal	NaOH, KOH, HF, HNO_3, HCl, etc.	Kalrez® PV8030
ARC Coating	SiH_4, NH_3, O_2 Plasma PECVD or Reactive Sputtering, In-Situ NF_3 Plasma Cleaning	Zalak® 5300/Kalrez® PV8050*
Metallization	Drying/Firing Process	Kalrez® PV8070

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	PV8070/PV8050
Abatement Systems (“Wet” Scrubbers)	Strong Acids/Bases	PV8030

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

* Note - The order of the process steps can be different depending upon the module construction sequence.

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® 9100/Zalak® 5300*
• CIS/CIGS		
○ Diffusion	500–550 °C, H_2Se, H_2S Diffusion	Kalrez® PV8070
○ CdS Buffer Deposition	65 °C, Cd & S Salts Dissolved in NH_4OH	Kalrez® PV8030
○ Cu (In, GA) Sputtering	400-600 °C, Vacuum	Zalak® 5300
• Cadmium Telluride		
○ Single Side Activation	400 °C, $CdCl_2$ Dissolved in Methanol,	Kalrez® PV8050
○ Cadmium Etching	Concentrated H_3PO4, HNO_3	Kalrez® PV8030
○ CdS Buffer Deposition	65 °C, Cd & S Salts Dissolved in NH_4OH	Kalrez® PV8030
TCO Deposition/Front Contact	ZnO Reactive Sputtering	Zalak® 5300
	Diethyl Zinc (DEZ) MOCVD	Kalrez® PV8030

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

Suggested Products for Photovoltaic Use

DuPont™ Kalrez® PV8030

Kalrez® PV8030 perfluoroelastomer parts are a black product for PV cell manufacturing processes requiring resistance to “wet” process/cleaning chemistry including sawing damage removal, wafer surface texturing, P silicate removal and CdS buffer layer chemical bath deposition. It exhibits excellent resistance to aggressive chemicals including strong acids, bases, solvents and metal organic precursors. It also offers low metallic, anionic and total organic carbon (TOC) extractables and has excellent (low) compression set properties. Kalrez® PV8030 has good mechanical strength properties and is well suited for both static and dynamic sealing applications. A maximum continuous service temperature of 275 °C is suggested.

DuPont™ Kalrez® PV8050

Kalrez® PV8050 perfluoroelastomer parts are a white product for PV cell manufacturing processes requiring resistance to “dry” process chemistry including TCS-based thermal CVD for poly-silicon feedstock production, plasma edge isolation and silicon nitride ARC Deposition. It exhibits very low weight loss in oxygen and fluorine-based plasma. It also offers excellent resistance to chlorine gas and has excellent (low) compression set and outgassing properties. Kalrez® PV8050 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.

DuPont™ Kalrez® PV8070

Kalrez® PV8070 perfluoroelastomer parts are a black product for PV cell manufacturing processes requiring high temperature resistance including doping for n-type layer formation (bulk c-Si), diffusion for Diselenide thermal implantation (CIGS) and TCS-based thermal CVD for poly-silicon feedstock production. 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 excursion to higher temperatures may also be possible.

DuPont™ Kalrez® 9100

Kalrez® 9100 perfluoroelastomer parts are an amber translucent product for 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.

DuPont™ Zalak® 5300

Zalak® high performance seals are a beige translucent product that has been specially formulated for use in plasma environments, e.g., ARC coating in crystalline silicon cell manufacturing, TCO sputtering deposition and selective a-Si PECVD applications in thin film cell manufacturing. The low erosion rate of Zalak® 5300 in different plasma environments enables the PV cell manufacturing equipment to operate longer with reduced maintenance, effectively reducing the cost of equipment ownership. It also exhibits low “stiction” (sticking), good resistance to “dry” process chemistry and has excellent compression set properties. A maximum continuous service temperature of 200 °C is suggested.

Photovoltaic Product Information

Typical Physical Properties[1]

Product	Color	Hardness[2] Shore M (O-ring)	Maximum Continuous Service Temperature[3], °C	Compression Set, 70 hrs at 204 °C[4], %
Kalrez® PV8030	Black	83	275	30
Kalrez® PV8050	White	72	300	17
Kalrez® PV8070	Black	83	325	14
Kalrez® 9100	Amber Translucent	74	300	17
Zalak® 5300	Beige Translucent	65	200	35

[1] Not to be used for specification purposes

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

[3] DuPont Performance Polymers proprietary test method

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

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Contact DuPont at the following regional locations:

North America
800-222-8377

Latin America
+0800 17 17 15

Europe, Middle East, Africa
+41 22 717 51 11

Greater China
+86-400-8851-888

ASEAN
+65-6586-3688

Japan
+81-3-5521-8484

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Caution: Do not use in medical applications involving permanent implantation in the human body. For other medical applications, discuss with your DuPont customer service representative and read Medical Caution Statement H-50103-3.

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