

Gas Purification for Silicon-Based Thin-Film Photovoltaic Cell Production

Plasma-enhanced chemical vapor deposition (PECVD), chemical vapor deposition (CVD), and dry etching are processes used in the fabrication of silicon-based thin-film photovoltaic cells. Molecular impurities in the process gases such as siloxanes and moisture can lead to process inconsistencies, ultimately leading to wafer level defects and reduced product yield. The addition of Pall purification products can significantly reduce these impurities.

Contamination in process gases lead to yield reduction

Common process feedstock gases used in PECVD and CVD tools consist of silane, hydrogen, germane, and ammonia. The post-deposition etching is performed with the use of corrosive gases such as hydrogen chloride (HCl) and hydrogen bromide (HBr).

Moisture contamination in the process line can cause a reaction with the silane gas, forming silicon dioxide nuclei. If the nuclei condenses, siloxanes are formed which can cluster and form particles. This reaction can take place upstream or downstream of a particle filter.¹ The installation of a Gaskleen® purifier assembly with our AresKleen™ SIP material will remove the moisture and siloxanes, which will significantly reduce the particle formation.

HCl and HBr are highly corrosive gases that can form a strong acid in the presence of moisture that will corrode most metals including 316L stainless steel. Hence, the removal of moisture in both gases is essential in preventing any corrosive effects to both the gas line and associated equipment such as regulators, valves & MFCs. The reduction of moisture will be greatly enhanced by using a Pall purifier with AresKleen HCLP or HBRP purification media.

¹ "Elimination siloxane impurities from silane process gas using next-generation purification". B. Gotlinsky, J. O'Sullivan, S. Babasaki. Micro, July / August 2000.

Pall's SIP purification material reduces siloxane levels in silane gas

Test data has demonstrated that our AresKleen SIP medium has a strong affinity for removal of siloxane impurities in silane gas. When challenged with 500 ppb of moisture, a Pall Mini Gaskleen purifier assembly with SIP medium was able to remove siloxanes to sub-ppb levels as shown with APIMS analyzer testing (shown in Figures 1 and 2). In addition, on-wafer particulate identification was performed before and after purification of the silane

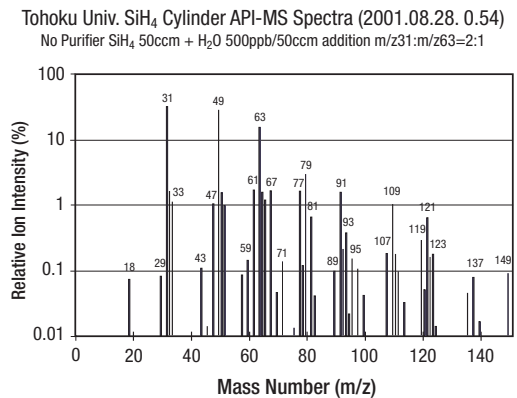


Figure 1: APIMS spectra in silane without purification

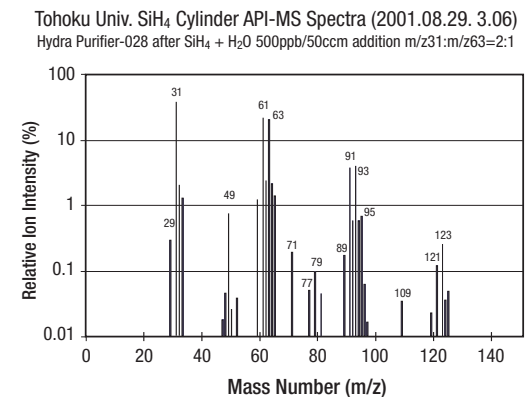


Figure 2: APIMS spectra in silane after installing a Mini Gaskleen purifier, P/N GLPSIPVM4

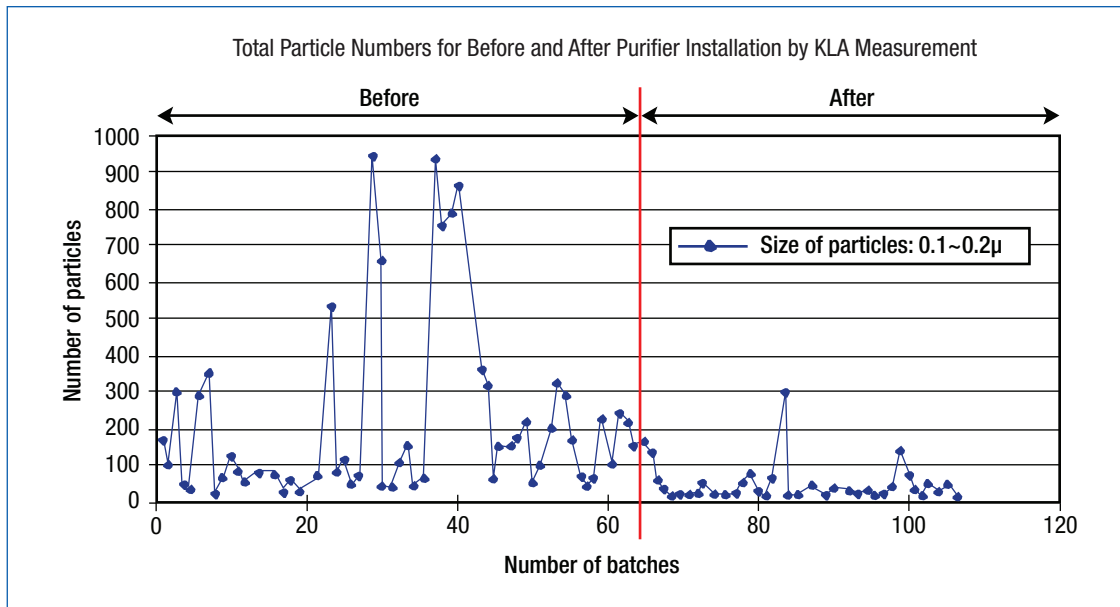


Figure 3: On wafer particle data before and after using a Pall purifier in silane gas service

process gas stream. As shown in Figure 3, particle levels were significantly lower after the installation of a purifier.

Pall's HCLP and HBRP purification materials reduce moisture levels in corrosive gases

The AresKleen HCLP and HBRP medium have a strong affinity for moisture removal in HCl

and HBr, respectively. A Gaskleen II purifier with HCLP material has demonstrated effective removal of moisture to sub-15 ppb levels in 90% HCl / 10% Ar service using CRDS testing (Figure 4). A Gaskleen II purifier with HBRP material has demonstrated effective removal of moisture to sub-50 ppb levels in 90% HBr / 10% Ar service using CRDS testing (Figure 5).

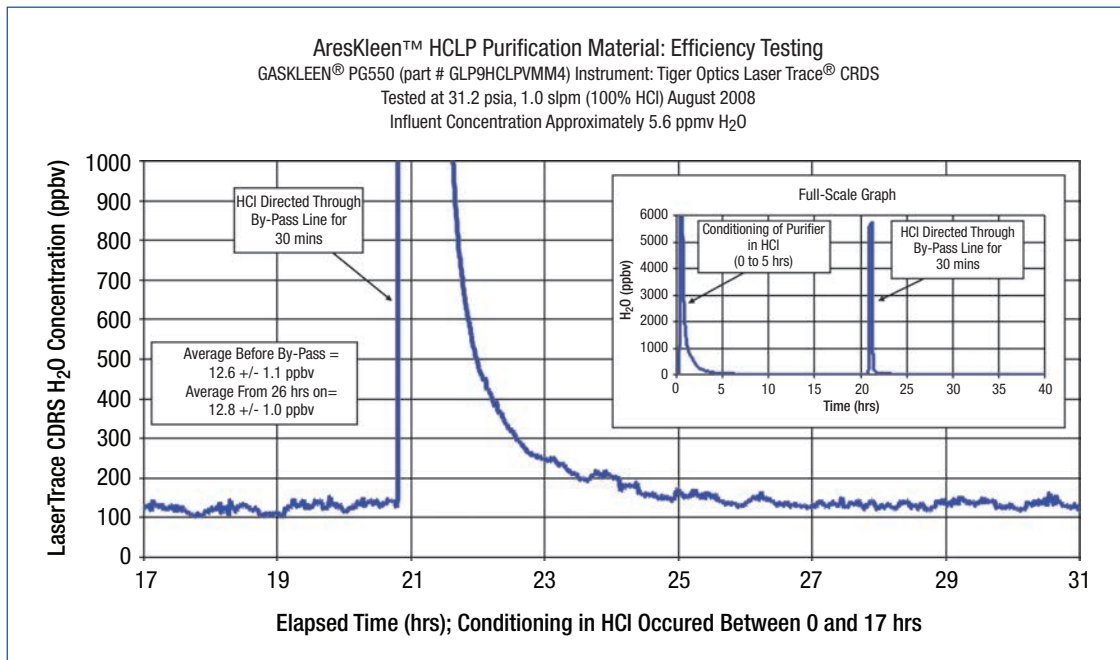


Figure 4: Pall AresKleen HCLP Purification Material: 90% HCl / 10% Ar Service with a > 5 ppm moisture challenge

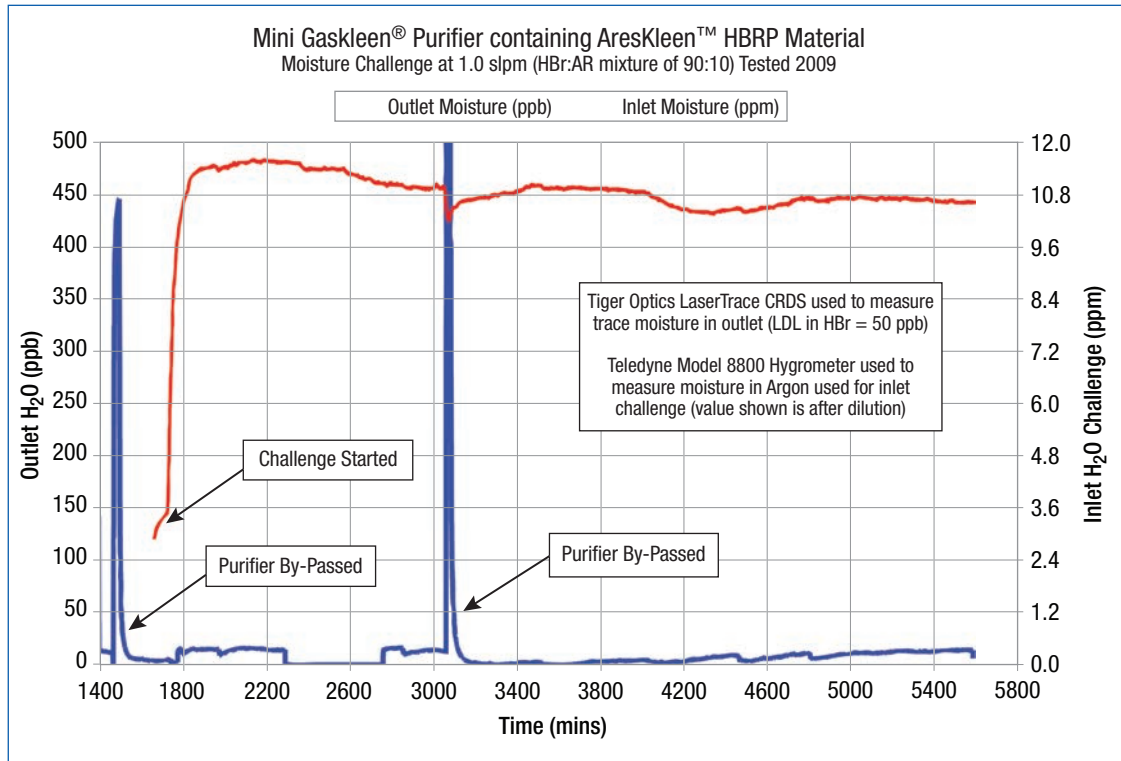


Figure 5: Pall AresKleen HBRP Purification Material: 90% HBr / 10% Ar service with a > 5 ppm moisture challenge

Process benefits

The Gaskleen purifier with SIP purification material has been shown to remove siloxanes to low levels in process gas. The result is minimal detrimental particles in the distribution system and on the wafer surface.

The Gaskleen purifiers with HCLP and HBRP purification materials have been shown to remove moisture to very low levels in HCl and

HBr gases, respectively. A reduction in moisture significantly reduces the potential for harmful corrosion of gas distribution piping and components, as well as particle generation.

Product features and benefits

Specific features of the Gaskleen SIP, HCLP and HBRP purifiers have associated benefits over other commercially available technologies.

Feature	Benefit
Inorganic substrate	Provides good stability during operation
Room temperature operation	Eliminates the need for heating or cooling sources
Purification process works through chemisorption	Contaminants are strongly bound to substrate
Small, uniform substrate	Allows for a tightly packed bed which a) Enables the purifier to be installed in either the horizontal or vertical position (orientation insensitive) b) Provides sharp breakthrough and accurate estimate of purifier's service life.
Integral 3 nm metal filter	Removes particles that lead to yield-reducing defects



Recommended Gaskleen purifiers

Mini Gaskleen purifier, P/N's GLPSIPVMM4, GLPHCLPVMM4, GLPHBRPVMM4:

Rated for 1 slpm, ¼" gasket seal (VCR² compatible) connections.

(Refer to the product data sheet at <http://www.pall.com/pdf/A79.pdf>)

Gaskleen II purifier, P/N's GLP2SIPVMM4, GLP2HCLPVMM4, GLP2HBRPVMM4:

Rated for 3 slpm, ¼" gasket seal (VCR compatible) connections.

(Refer to the product data sheet at http://www.pall.com/pdf/A88_Gaskleen_II_Purifier.pdf)

Gaskleen ST purifier, P/N's GLP5SIPVMM4, GLP5HCLPVMM4, GLP5HBRPVMM4:

Rated for 5 slpm, ¼" gasket seal (VCR compatible) connections.

(Refer to the product data sheet at <http://www.pall.com/pdf/A87.pdf>)

Larger flow purifiers are also available.

Please visit www.pall.com for further details.

² VCR is a trademark of Swagelok Company.



Pall Corporation

Microelectronics

25 Harbor Park Drive
Port Washington, NY 11050
+1 516 484 3600 telephone
+1 800 360 7255 toll free US

Portsmouth - UK
+44 (0)23 9230 3303 telephone
+44 (0)23 9230 2507 fax
processuk@pall.com

Visit us on the Web at www.pall.com/web location

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