NIPPON GASES
The Gas Professionals

Product Specifications

NANOCHEM®
Complete Purification Solutions with NANOCHEM® Purifiers

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Complete Purification Solutions with NANOCHEM® Purifiers

Since 1985, MATHESON NANOCHEM® purifiers have provided unprecedented purification solutions to the electronic industry.

NANOCHEM® purifiers were the first point-of-use purifiers to deliver up to nine 9's purity gas to the semiconductor industry.

Today, NANOCHEM® purifiers offer comprehensive solutions for the source, point-of-use, bulk and proximate purification requirements of specialty gas users.

NANOCHEM® purifiers combine gas-specific purification media and ultra-high purity hardware in one system to eliminate impurities caused by:

- Upstream leaks
- Improper cylinder change-outs
- Increasing impurity concentration during gas cylinder depletion
- Gas system component contamination
- Virtual leaks from component / piping "dead pockets" and soft seats

NANOCHEM® purifiers offer the highest lifetimes and the best efficiencies for impurity removal. NANOCHEM® purifiers are available for:

- Silicon-source gases
- Nitride gases
- Etchants
- Purge gases
- Dopant gases
- Carrier gases

Oxygen, moisture and other contaminants are removed to < 100 ppt (parts per trillion) and are limited only by the detection limits of even state-of-the-art analytical instrumentation.

Compact and easy to use, NANOCHEM® purifiers can be installed within the gas cabinet or at the process tool. Most purifiers require no heating or cooling and are capable of handling a broad range of flows and pressures.

MATHESON has one of the most extensive, in-house evaluation laboratories in the industry to assess the quality of gas system components.

The benefit is that components selected for NANOCHEM® purification products are of the highest quality available. "Live gas" testing is done to ensure purifiers meet or exceed performance specifications in the specific process gas for which they are marketed.

Purification Performance Benefits & Applications

NANOCHEM® purifiers offer a number of benefits, such as reduced equipment downtime and protection against fluctuations in gas supply quality and upstream system upsets. Typical performance benefits for the semiconductor / compound semiconductor industry are:

- Increased carrier concentration, increased mobility
- Faster crystal growth rates
- Improved uniformity of surface morphology
- Fewer defects in epi layers and substrates
- Longer equipment life & reduced component corrosion

Applications include manufacture of ICs and high brightness LEDs, piping for semiconductor fabs, manufacture of aerospace components, manufacture of process equipment for chemical and biotech industries, and additive manufacturing.

NANOCHEM®
Purification Media

NANOCHEM® purification media have long been the industry standards for purifying inert gases, such as nitrogen, argon, and sulfur hexafluoride, as well as reactive gases, such as hydrogen, hydrocarbons, and hydride gases (including ammonia, silane, arsine and phosphine).

Applications include biotech, chemical processing, aerospace, analytical, petroleum refining, semiconductor / compound semiconductor processes, including low temperature SiGe Epi, SiN and GaN MOCVD processes, and additive manufacturing.

Gas Type	Contaminants	Outlet Purity
Inerts - Nitrogen (N_2), Argon (Ar), other inerts	H_2O	< 86 ppt
	O_2	< 50 ppt
	CO	< 100 ppt
	CO_2	< 24 ppt
	Benzene	< 156 ppq
	Toluene	< 93 ppq
	Ethylbenzene	< 96 ppq
	m,p-Xylene	< 79 ppq
	o-Xylene	< 112 ppq
	Refractories*	< 134 ppq
	H_2	< 1 ppb
Ammonia (NH_3)	H_2O	< 45 ppb
	O_2	< 0.1 ppb
	CO_2	< 11 ppb
	Carbamate	< 11 ppb
	GeH_4	< 1 ppb
	SiH_4	< 3 ppb
	Siloxanes	< 40 ppb
	Metals	
	Al	< 0.6 ppb
	Cu	< 0.27 ppb
	Fe	< 0.8 ppb
	K	< 0.35 ppb
	Na	< 0.27 ppb
	Si	< 1.3 ppb
	W	< 0.11 ppb
	Zn	< 0.27 ppb
	Zr	< 0.11 ppb

Gas Type	Contaminants	Outlet Purity
Ammonia (NH_3) - continued	**Hydrocarbons from Liquid NH_3**	
	Napthenic and Paraffins	85% removal
	Ethyl Benzene	96% removal
	Dissolved other HC	<200 ppb
	Hydrocarbons from Gaseous NH_3	
	n-Butane	< 30 ppb
	Ethylbenzene	< 30 ppb
Carbon Dioxide (Purifier material HCX)	Isopropyl Alcohol	< 200 ppt
	Acetone	< 93 ppt
	Propene	< 1 ppt
	Ethanol	< 1 ppt
	Carbon Disulfide	< 1 ppt
	Hexane	< 1 ppt
	Benzene	< 1 ppt
Carbon Dioxide (Purifier material HCX) continued	Heptane	< 1 ppt
	Toluene	< 1 ppt
	m,p-Xylene	< 1 ppt
	o-Xylene	< 1 ppt
	Ethyl Toluene	< 1 ppt
	1,3,5-Trimethyl Benzene	< 1 ppt
	1,2,4-Trimethyl Benzene	< 1 ppt
	DichloroBenzene	< 1 ppt
Silane (SiH_4)	H_2O	< 100 ppt
	O_2	< 100 ppt
	CO_2	< 100 ppt
	CO**	< 1 ppb
	Chlorosilanes, disilane, siloxanes, arsine, phosphine	

Gas Type	Contaminants	Outlet Purity
Hydrogen (H_2)	H_2O	< 100 ppt
	O_2	< 100 ppt
	CO_2	< 100 ppt
Methane (CH_4)	CO**	< 1 ppb
Ethane (C_2H_6), other HC	NOx, SOx, H2S	
Sulfur Hexafluoride (SF_6)	H_2O in inert gas	< 100 ppt
	O_2 in inert gas	< 100 ppt
	CO_2 in inert gas	< 100 ppt
Carbon Tetrafluoride (CF_4)	H_2O in sulfur hexafluoride	< 10 ppb
	O_2 in sulfur hexafluoride	< 10 ppb
Other Fluorocar-bons	H_2O in sulfur hexafluoride	< 10 ppb
	O_2 in sulfur hexafluoride	< 10 ppb
Oxygen (O_2),	H_2O	< 10 ppb
Carbon Dioxide (CO_2),	H_2O	< 10 ppb
Nitrous Oxide (N_2O)	H_2O	< 10 ppb
Carbon Monoxide (CO)	Metal Carbonyls: Fe, Ni	
Corrosives (HCl, HBr, Cl_2, SiH_2Cl_2, $SiHCl_3$, BCl_3)	H_2O in inert gas	< 1 ppb
	H_2O in HBr	< 100 ppb
	H_2O in HCl	< 100 ppb
	Volatile Metals* **	
	Mo	< 4 ppb
	Ti	< 13 ppb
	Fe(CO)5	< 50 ppb

Impurity removal depends on purifier material and incoming gas specification

*Refractories as TMDSO (Tetramethyldisiloxane)

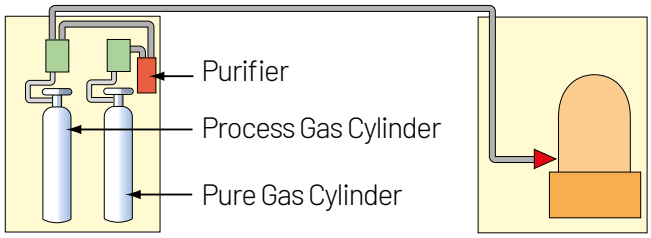
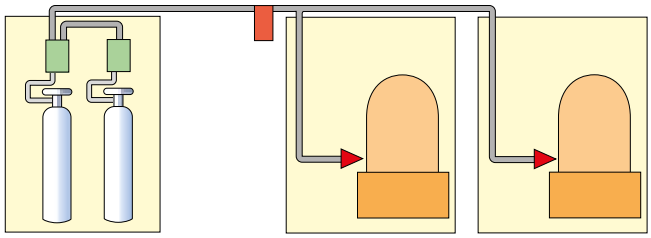
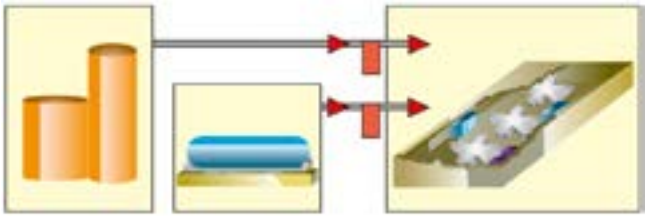
**CO is removed efficiently by OMX & OMX-PlusTM media at low flow rates (recommend 1/10 of normal flow rate)

***Metals removed as measured on wafer via VPD-ICPMS:
Al, Ca, Cr, Fe, Mg, Ni, K, Na, Zn

Metals removal as demonstrated by intrinsic resistivity measurements on wafer grown by TCS:

- Without MTX Purifier: <200 ohm-cm
- With MTX Purifier: > 2500 ohm-cm and total metals on water <1E10 atoms/cm_2

Purification Applications - Where to Use Purification

		Gas cabinet	Distribution Line	Process tool
Purge gas purification ensures that cylinder changes do not contaminate the process lines and that the purest purge gas is used.	1			
Source gas purification of corrosive gases ensures that cylinder moisture does not corrode the purge manifold, distribution or process lines.	2			
Proximate gas purification allows economical purification with a single source purifier for multi-tool applications.	3			
Point-of-connection gas purification ensures process gas consistency for larger flow applications.	4			
Point-of-use gas purification eliminates virtually all variables of contamination including gas jungle variables. Typical location would be directly before the chamber or mass flow controller.	5			
Bulk gas purification offers economical purification to a central area or entire facility.	6		Bulk Gas Tanks	FAB
Replacement purifiers for replacement of other brand purifiers, previously installed.*	7			

* Drop-In Replacement with identical dimensions

Purification Applications – Where to Use Purification

POINT-OF-USE Purification

PuriFilter®
- Up to 3 slpm (0.18 NM_3/hr)
- 1000 psig (7 MPa) rating
- Poppet valves limit exposure to atmosphere during purifier installation
- Poppet valves limit exposure to residual process gas during purifier replacement

L-Series
- Up to 150 slpm (9 NM_3/hr)
- Inlet / outlet valves
- Optional 3-valve Bypass
- Optional electronic end-point detection
- 150 psig (1.1 MPa) with end-point
- 500 psig (3.5 MPa) without end-point

White Knight Series™
- Competitor Drop-In Replacement Design
- Up to 1000 slpm (60 NM_3/hr)
- Up to 500 psig (3.5 MPa)
- Optional poppet valves
- Optional inlet & outlet valves
- Optional bypass assembly

H-Series
- Ultra-clean construction
- Built-in 1-valve bypass
- Up to 50 slpm (3 NM_3/hr) with H-Series
- Optional electronic endpoint detection
- 150 psig (1.1 MPa) with end-point
- 500 psig (3.5 MPa) without end-point

A-Series
- For 100% arsine & phosphine service
- For use in ASM & MATHESON SideCar™ custom purification cabinet
- Optional electronic endpoint detection
- Up to 20 slpm (1.2 NM_3/hr) in AsH_3/PH_3 service
- Up to 60 psig (0.4 MPa) in AsH_3/PH_3 service
- Up to 150 slpm (9 NM_3/hr) in inert gas service
- Up to 500 psig (3.5 MPa) in inert gas service
- Competitor Drop-In Replacement Design

HIGH PRESSURE Purification (Source)

HP-Series
- For installation after cylinder CGA connection
- Reduce manifold corrosion with corrosive gases
- Up to 2,850 psig (19.7 MPa)
- Flow rates up to 50 slpm (3 NM^3/hr)
- Built-in 1-Valve Bypass

MAX™
- High capacity, high flow, and high pressure
- 10L volume
- Up to 5000 slpm (180 m^3/h) and 3000 psig (207 bar)
- Sub-ppt efficiency

HIGH TECHNOLOGY WELDING Purification

WeldAssure™ Series
- Up to 50 slpm (100 cfh, 3 NM^3/hr))
- Up to 200 psig (1.5 MPa)
- Built-in 1-valve (4-Way valve) bypass
- Check valve at outlet to protect canister media from air intrusion when gas flow is stopped
- Visual end-point detection
- Field-replaceable canister
- Inexpensive – Brass components & disposable aluminum canister
- Optional refillable stainless canister
- Optional stainless components with stainless canister

Weld Knight™ Series
- Up to 250 slpm (530 cfh, 15 NM^3/hr)
- Up to 200 psig (1.5 MPa)
- Built-in 1-valve (4-Way valve) bypass
- Check valve at outlet to protect canister media from air intrusion when gas flow is stopped
- Field-replaceable canister
- Refillable stainless steel canister
- Stainless valves and fittings

BULK Purification

Megashield™ (MS-Series)
- Up to 1000 slpm (60 NM^3/hr)
- Up to 150 psig (1.1 MPa) with end-point
- Up to 350 psig (2.5 MPa) without end-point
- Optional bypass manifold

CUSTOM Purification

SideCar™

- Custom cabinet with A-Series H_2, N_2 and HCl purifiers
- Designed for ASM America Epsilon and Polygon tools
- Can be used as stand-alone cabinet
- Optional NanoShield process protection system
- Up to 100 psig (0.7 MPa)
- H_2 and N_2: Up to 150 slpm (9NM_3/hr)
- HCl: Up to 50 slpm (3 NM_3/hr)

Pico-Trap™

- Acetone removed to 500 ppm ±100 ppm
- C_2H_2 cylinder pressure ranges between 280 psig and 50 psig
- C_2H_2 flow up to 14 slpm
- Operating Pressure ±1 psig
- Operating Temperature ±1°C

ADDITIVE MANUFACTURING Purification

3DPro™

- 57 liter purifier
- Removal of water only or removal of water and oxygen to less than 1 ppb
- Temperature probe and readout is available to monitor the internal temperature of purifier bed
- High flow ball valves and gate valve used for lowest pressure drop
- Flow rates up to 5000 slpm depending on customermaximum allowable pressure drop
- Maximum operating pressure is 125 psig
- Maximum operating temperature is 40°C

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