

# 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*

Semiconductor applications include manufacture of ICs and high brightness LEDs. Welding applications include piping for semiconductor fabs, manufacture of aerospace components, and manufacture of process equipment for chemical and biotech industries.



**MATHESON**

ask. . . The Gas Professionals™

## Gas Specific Purification

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, and semiconductor / compound semiconductor processes, including low temperature SiGe Epi, SiN and GaN MOCVD processes. Over twelve (**12**) different purification media are available to purify about **40** different gases.

## NANOCHEM® Media -- Gases Purified & Specifications

GASES PURIFIED	CHEMICAL FORMULA	PURIFICATION MEDIUM	PURIFICATION MEDIUM DESCRIPTION	IMPURITIES REMOVED	EFFICIENCY	END POINT DETECTION
<b>Inerts</b>						
Nitrogen Argon Helium Xenon Krypton Neon	N <sub>2</sub> Ar He Xe Kr Ne	OMX-Plus™	Reactive agents on a polymeric support w/ inorganic agent for NMHC removal	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> , THC except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL  CO at Low Flow	DC only  < 1 ppb
		HCX™	High surface area inorganic medium	Hydrocarbons except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL	Not available
		In2Go™	Reactive agents on an inorganic support	H <sub>2</sub> O, O <sub>2</sub> , CO, CO <sub>2</sub> THC except CH <sub>4</sub> Halocarbons	< 100 ppt, LDL	DC only
<b>Flammables - Partial List</b>						
Methane Ethane Cyclopropane Propane Butane	CH <sub>4</sub> C <sub>2</sub> H <sub>6</sub> C <sub>3</sub> H <sub>8</sub> C <sub>4</sub> H <sub>10</sub>	OMX-Plus™	Reactive agents on a polymeric support w/ inorganic agent for NMHC removal	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> , THC except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL  CO at Low Flow	DC only  < 1 ppb
		OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub>	< 100 ppt, LDL CO at Low Flow	DC only < 1 ppb
Hydrogen Deuterium	H <sub>2</sub> D <sub>2</sub>	OMX-Plus™	Reactive agents on a polymeric support w/ inorganic agent for NMHC removal	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> , THC except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL  CO at Low Flow	DC only  < 1 ppb
		HCX™	High surface area inorganic medium	Hydrocarbons except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL	Not available
		In2Go™	Reactive agents on an inorganic support	H <sub>2</sub> O, O <sub>2</sub> , CO, CO <sub>2</sub> THC except CH <sub>4</sub> Halocarbons	< 100 ppt, LDL	DC only

Please contact customer service for other flammables, that can be purified.

### Halocarbons - Partial List

Carbon Tetrafluoride	CF <sub>4</sub>	OMX-Plus™	Reactive agents on a polymeric support w/ inorganic agent for NMHC removal	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> , THC except CH <sub>4</sub> & Other Halocarbons CO at Low Flow	< 100 ppt, LDL  < 1 ppb	DC only
Hexafluoroethane	C <sub>2</sub> F <sub>6</sub>	OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> CO	< 100 ppt, LDL < 1 ppb	DC only
Perfluoropropane	C <sub>3</sub> F <sub>8</sub>	OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub>	< 100 ppt, LDL	DC only

Please contact customer service for other halocarbons, that can be purified.

ppb = Part per billion

ppt = Part per trillion

THC = Total Hydrocarbons

LDL = Lower Limit of Detection by state-of-the-art analytical instrumentation.

Please contact customer service for other gases not included in this list

## NANOCHEM® Media -- Gases Purified & Specifications (continued)

GASES PURIFIED	CHEMICAL FORMULA	PURIFICATION MEDIUM	PURIFICATION MEDIUM DESCRIPTION	IMPURITIES REMOVED	EFFICIENCY	END POINT DETECTION
<b>Hydrides</b>						
Ammonia	NH <sub>3</sub>	In2Go™	Reactive agents on an inorganic support	H <sub>2</sub> O	< 10 ppb, LDL	DC only
				CO <sub>2</sub>	< 11 ppb, LDL	
				O <sub>2</sub>	< 5 ppb, LDL	
				GeH <sub>4</sub>	< 1 ppb, LDL	
				SiH <sub>4</sub>	< 1 ppb, LDL	
		TEOS	< 40 ppb, LDL			
		OMA™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> in inert gas	< 100 ppt, LDL	DC only
Silane	SiH <sub>4</sub>	OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub> , CO	< 100 ppt, LDL	DC only
Arsine	AsH <sub>3</sub>	ASX-II™	High surface area inorganic medium	< 75 ppb H <sub>2</sub> O in AsH <sub>3</sub>	LDL	Not available
Phosphine	PH <sub>3</sub>	PHX™	Reactive agents on an inorganic support	< 33 ppb H <sub>2</sub> O in PH <sub>3</sub>	LDL	Not available
Germane	GeH <sub>4</sub>	Desicore™	Reactive agents on an inorganic support	< 5 ppb H <sub>2</sub> O in GeH <sub>4</sub>	LDL	Not available
<b>Hydride/Inert Mixes (N<sub>2</sub>, Ar, He, Xe, Kr, Ne, &amp; H<sub>2</sub>)</b>						
1-10% Arsine	AsH <sub>3</sub>	OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub>	< 1 ppb	Not available
1-10% Germane	GeH <sub>4</sub>					
1-10% Phosphine	PH <sub>3</sub>					
<b>Corrosives</b>						
Boron Trichloride	BCl <sub>3</sub>	Metal-X™	High purity high surface area inorganic medium	H <sub>2</sub> O < 100 ppb, LDL Volatile Metals-Fe, Mo, Cr, Ti, Ni, Mn		Not available
Chlorine	Cl <sub>2</sub>					
Silicon Tetrachloride	SiCl <sub>4</sub>					
Trichlorosilane	SiHCl <sub>3</sub>					
Dichlorosilane	SiH <sub>2</sub> Cl <sub>2</sub>					
Hydrogen Bromide	HBr					
Hydrogen Chloride	HCl					
Hydrogen Fluoride	HF	CleanCorr™	High high surface area inorganic medium	H <sub>2</sub> O < 2 ppm, LDL		Not available
<b>Others</b>						
Carbon Monoxide	CO	Metal-X™	High purity high surface area inorganic medium	H <sub>2</sub> O < 100 ppb, LDL Volatile Metals-Fe, Mo, Cr, Ti, Ni, Mn		Not available
Nitric Oxide	NO					
Carbon Dioxide	CO <sub>2</sub>	OPX™	High surface area inorganic medium	H <sub>2</sub> O	< 10 ppb	Not available
		HCX™	High surface area inorganic medium	Hydrocarbons except CH <sub>4</sub> Halocarbons except CF <sub>4</sub>	< 100 ppt, LDL	Not available
Nitrous Oxide	N <sub>2</sub> O					
Oxygen	O <sub>2</sub>	OPX	High surface area inorganic medium	H <sub>2</sub> O	< 10 ppb	Not available
Dimethyl Ether	(CH <sub>3</sub> ) <sub>2</sub> O	OMX™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub> , CO <sub>2</sub>	< 100 ppt, LDL	DC only
Sulfur Hexafluoride	SF <sub>6</sub>	OMS™	Reactive agents on a polymeric support	H <sub>2</sub> O, O <sub>2</sub>	< 10 ppb, LDL	DC only
Acetylene	C <sub>2</sub> H <sub>2</sub>	AcetyClean™	High high surface area inorganic medium	H <sub>2</sub> O	< 1 ppm, LDL	Not available

ppm = Part per million

ppb = Part per billion

ppt = Part per trillion

THC = Total Hydrocarbons

LDL = Lower Limit of Detection by state-of-the-art analytical instrumentation.

**Please contact customer service for other gases not included in this list**

**NOTE:** Shown above are specifications for impurities removed by NANOCHEM® gas purification media. However, individual media may remove many other impurities, not listed above. For example, NANOCHEM® OMX™ and OMX-Plus™ will also remove siloxanes, chlorosilanes, and disilane in silane service and Halocarbon 11, Halocarbon 12, Halocarbon 113 in dimethylether service. CleanCorr™ may also remove hydrocarbons from hydrogen fluoride.

# Purification Applications - Where to Use Purification

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

\* Drop-In Replacement with identical dimensions

## Purification Applications - *Where to Use Purification*

### POINT-OF-USE Purification



#### MiniSentry™

- Up to 1 slpm (0.06 NM<sup>3</sup>/hr)
- 3000 psig (20.8 MPa) rating
- Diffusion barrier limits exposure to atmosphere during installation



#### PuriFilter®

- Up to 3 slpm (0.18 NM<sup>3</sup>/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

### PROXIMATE Purification (Larger Flow than POU)



#### L-Series, J-Series

- Up to 150 slpm (9 NM<sup>3</sup>/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
- J-Series with Fujikin valves



#### H-Series

- Ultra-clean construction
- Built-in 1-valve bypass
- Up to 50 slpm (3 NM<sup>3</sup>/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 Tri-Gas SideCar™ custom purification cabinet
- Optional electronic endpoint detection
- Up to 20 slpm (1.2 NM<sup>3</sup>/hr) in AsH<sub>3</sub>/PH<sub>3</sub> service
- Up to 60 psig (0.4 MPa) in AsH<sub>3</sub>/PH<sub>3</sub> service
- Up to 150 slpm (9 NM<sup>3</sup>/hr) in inert gas service
- Up to 500 psig (3.5 MPa) in inert gas service
- Competitor Drop-In Replacement Design



#### White Knight Series™

- Competitor Drop-In Replacement Design
- Up to 1000 slpm (60 NM<sup>3</sup>/hr)
- Up to 500 psig (3.5 MPa)
- Optional poppet valves
- Optional inlet & outlet valves

NOTE: 0.003  $\mu$ m particulate filter with 9-log retention standard on most purifier models.  
Optional on L-60, MS-Series.

## BULK Purification



### Megashield™ (MS-Series)

- Up to 1000 slpm (60 NM<sup>3</sup>/hr)
- Up to 150 psig (1.1 MPa) with end-point
- Up to 350 psig (2.5 MPa) without end-point
- Optional bypass manifold

## 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<sup>3</sup>/hr)
- Built-in 1-Valve Bypass

## High Technology Welding



### WeldAssure™ Series

- Up to 50 slpm (100 cfh, 3 NM<sup>3</sup>/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

## CUSTOM Purification



### SideCar™

- Custom cabinet with A-Series H<sub>2</sub>, N<sub>2</sub> 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<sub>2</sub> and N<sub>2</sub>: Up to 150 slpm (9NM<sup>3</sup>/hr)
- HCl: Up to 50 slpm (3 NM<sup>3</sup>/hr)

Specifications are subject to change. Please check [www.mathesongas.com](http://www.mathesongas.com) for most current information.

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