NANOCHEM® *In2Go*™ Purification Medium
NANOCHEM® *Inert Gas* and *Ammonia* Purifiers

The Next Generation Purifier for Inert Gases and Ammonia
All the Benefits of OMX™ and OMA™ Media with Stability to Air Intrusions

NANOCHEM® In2Go™ is an *inorganic* medium that provides high capacities and efficiencies and also *offers resistance to air intrusions*. NANOCHEM® In2Go™ not only removes H_2O, O_2, CO_2 and CO but also removes hydrogen sulfide and dopant impurities, such as silane, germane, and siloxanes in ammonia and inert gases. Byproducts upon accidental exposure to air are limited to easily removable compounds, such as carbon dioxide, moisture, trace methane and trace ammonia, which do not condense in process lines and can be purged from the system. NANOCHEM® In2Go™ is available in a wide range of purifier sizes from compact point-of-use to bulk purifiers capable of handling up to 1000 slpm.

Features and Benefits

- Purification of inert and flammable gases and ammonia used in ultra-high purity applications
- Ideal for SiGe Epi, GaN and SiN processes
- **Highest Lifetimes**
- **Best Impurity Removal Efficiencies**
- **Fiber Optic Endpoint Detection available**
- Removes oxygenated species (O_2, H_2O, CO, CO_2, NO_x, CO_x, etc) and trace dopants, such as silane, germane, and siloxanes
- Improves and ensures gas purity for process consistency
- Demonstrated improvements in process yield and device quality
- **No hydrocarbon breakdown with air intrusions**
- Does not require heating and cooling
- No external power source required, except for fiber optic sensor
- 0.003µm particle filter with 99.9999999% retention

Specifications

- < 0.1 ppb O_2, H_2O, CO_2, CO in inert gases, measured by API-MS
- < 5 ppb O_2 in ammonia, measured by GC-PID, LDL
- < 45 ppb H_2O in ammonia, measured by FTIR, LDL

ANALYTICAL PERFORMANCE

Typical Performance

Impurities are typically removed to the detection limits of state-of-the-art analytical techniques

Impurity/ Matrix	Efficiency (ppb)	Challenge (ppm)	Analytical Method
H_2O in Ar	< 0.3 (LDL)	35	API-MS
H_2O in NH_3	< 75 (LDL)	3.5	FTIR
CO_2 in He	< 11 (LDL)	500	GC-DID
CO_2 in NH_3	< 11 (LDL)	25	GC-DID
O_2 in NH_3	< 0.5 (LDL)	328	GC-PID
GeH_4 in N_2	< 0.1 (LDL)	2.5	API-MS
SiH_4 in N_2	< 0.1 (LDL)	2.5	API-MS
Siloxanes in N_2	< 0.1 (LDL)	(trace)	API-MS
GeH_4 in NH_3	< 1 (LDL)	0.5	GC-AED
SiH4 in NH_3	< 3 (LDL)	0.5	GC-AED
TEOS (siloxane) in NH_3	< 40 (LDL)	640	GC-DID

LDL	Lower Detection Limit of Analytical Test Method
APIMS	Atmospheric Pressure Ionization Mass Spectrometry
FTIR	Fourier Transform Infrared Spectrometry
GC-AED	Gas Chromatography with Atomic Emission Detector
GC-DID	Gas Chromatography with Discharge Ionization Detector
GC-PID	Gas Chromatography with Photo Ionization Detector
GF-AAS	Graphite Furnace Atomic Adsorption Spectrometry
ICP-MS	Inductively Coupled Plasma with Mass Spectrometry

NOTE: Detection limits of such instruments can vary from day to day.

Metal Emissions

Metal emissions of most elements from In2Go™ purifier in ammonia service are below the limits of detection (sub-ppb levels) by ICP-MS and GF-AAS. Only traces (< 1 ppb – 2 ppb) of Al, Ca, B, K, and Fe were detected. Such elements are usually contaminants in gas sampling systems.

MATHESON

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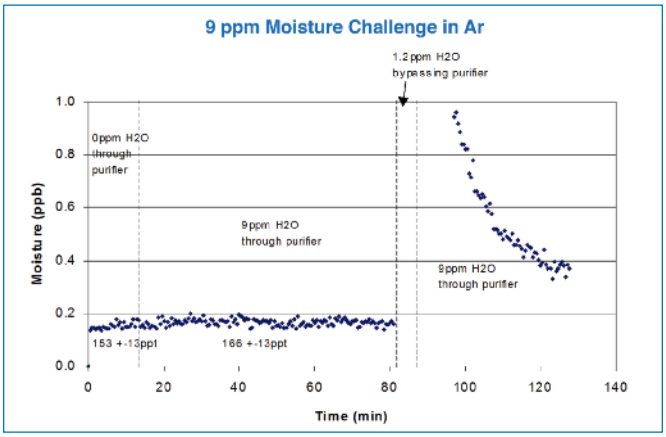
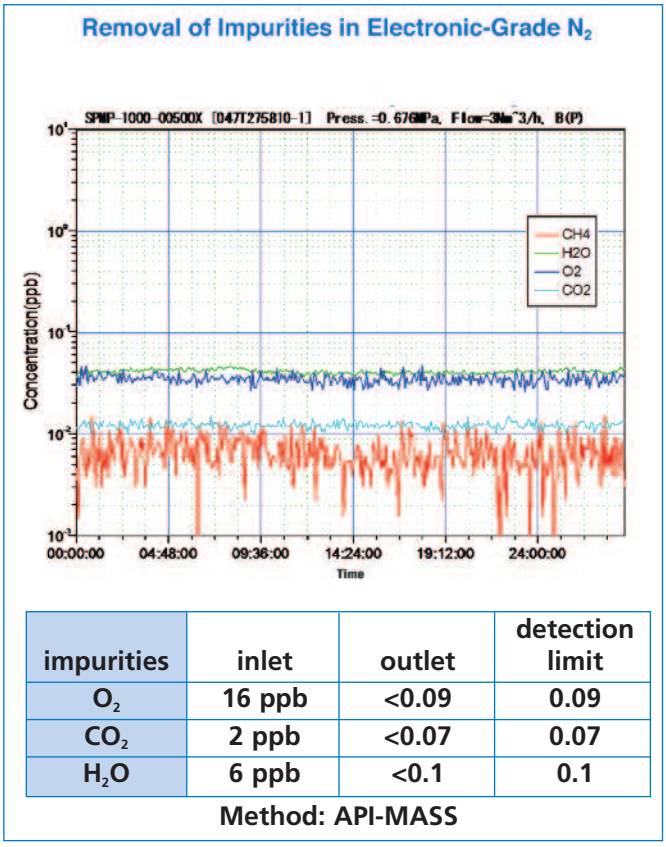
Capacity & Efficiency in Argon

NANOCHEM® In2Go™ offers high capacities and efficiencies.

The figure below shows that an inlet moisture content of 9 ppm in argon is reduced to < 0.2 ppb.



The figure below shows that oxygen, moisture, and carbon dioxide in electronic-grade nitrogen are reduced to < 0.1 ppb by NANOCHEM® In2Go™ medium.



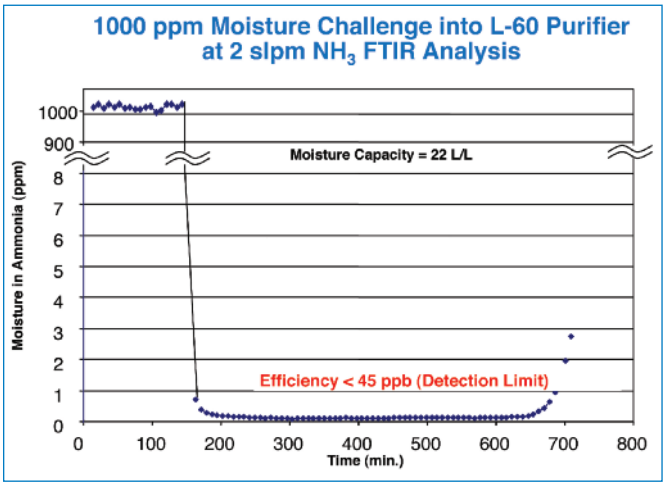
impurities	inlet	outlet	detection limit
O_2	16 ppb	<0.09	0.09
CO_2	2 ppb	<0.07	0.07
H_2O	6 ppb	<0.1	0.1

Method: API-MASS

Capacity and Efficiency in Ammonia

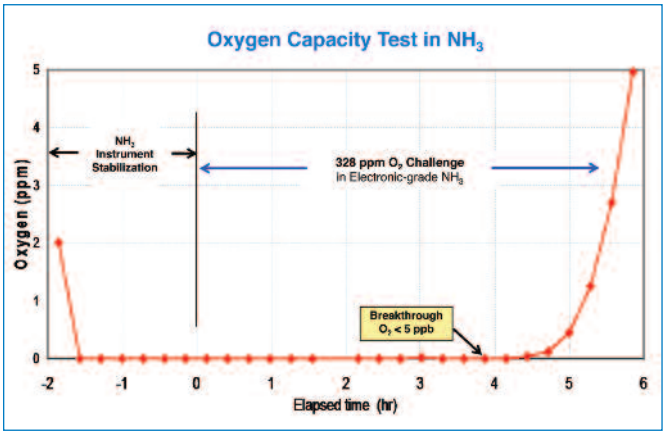
1. Removal of Moisture

In2Go™ offers the highest lifetime and the best efficiency, similar to NHX™-Plus for the removal of moisture in ammonia.



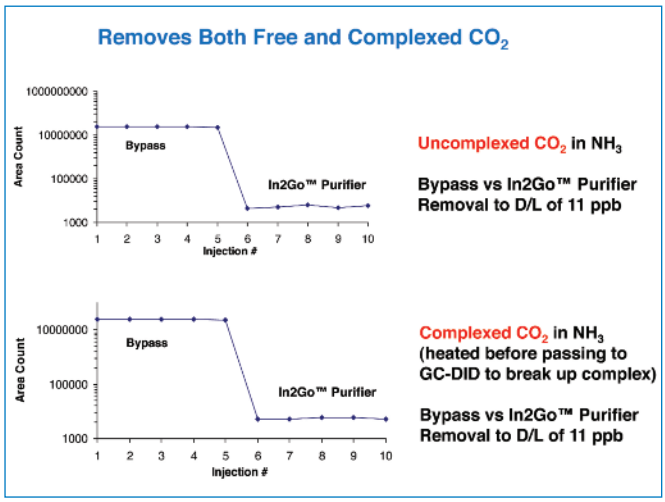
2. Removal of Oxygen

In2Go™ also offers high lifetimes and high efficiencies for the removal of oxygen in ammonia.



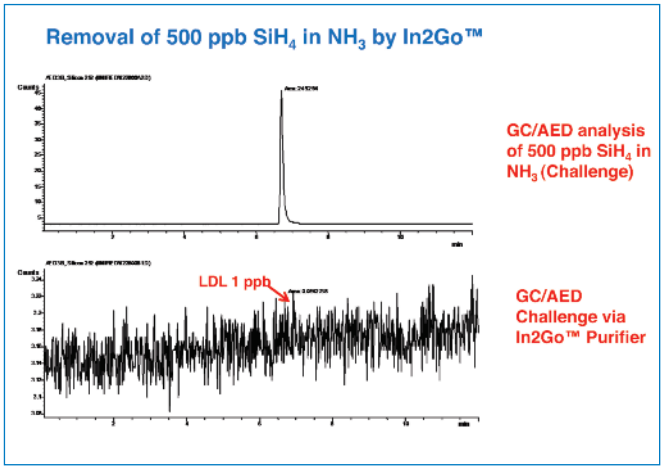
3. Removal of Free and Complexed CO_2

In2Go™ offers the best efficiency for the removal of NH_3 - CO_2 complexes. CO_2 is often present in the form of complexes, such as Carbamates ($NH_4CO_2NH_2$).



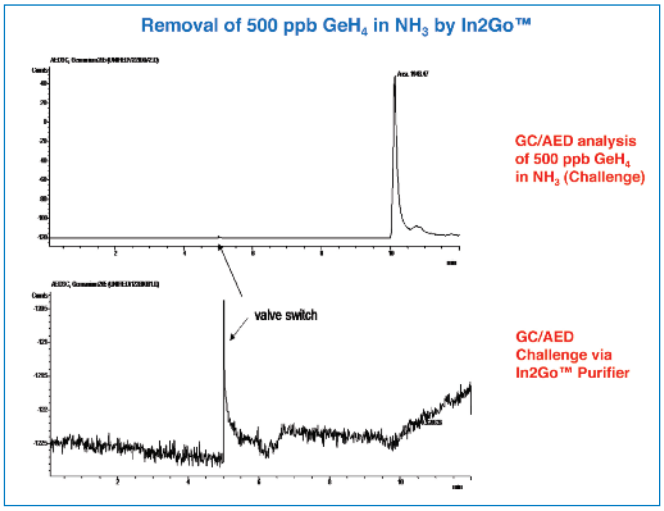
4. Dopant Removal – Removal of Silane (SiH_4) in NH_3

In2Go™ purifier was exposed to a challenge of 500 ppb silane in ammonia. The silane was completely removed – below the detection limits of ~ 1 ppb, measured by GC-AED. The lower figure (with an expanded scale for the baseline) indicates that the level of residual silane in the purified ammonia can't be distinguished from the baseline noise.



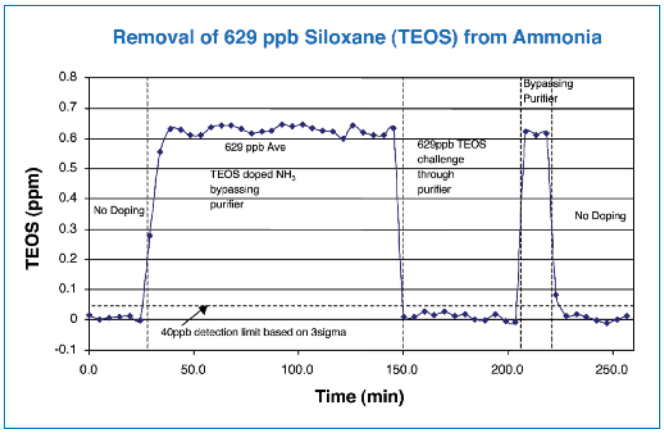
5. Dopant Removal – Removal of germane (GeH_4) in NH_3

In2Go™ purifier was exposed to a challenge of 500 ppb germane in ammonia. The germane was completely removed below the detection limits of ~ 1 ppb as measured by GC-AED. The lower figure with an expanded scale for the baseline indicates that the level of residual germane in the purified ammonia can't be distinguished from the baseline noise.



6. Dopant Removal – Removal of Siloxanes in NH_3

In2Go™ purifier was exposed to a challenge of 629 ppb of a siloxane (TEOS). The siloxane was completely removed to below the detection limits -- ~ 40 ppb.

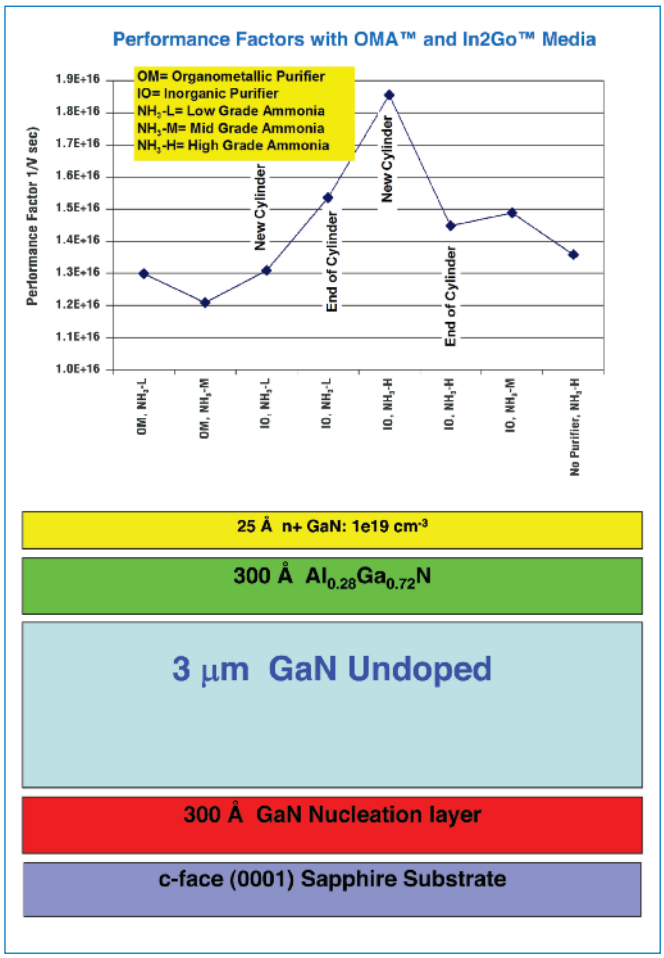


DEVICE PERFORMANCE

GaN films were grown on a sapphire substrate using a commercially available Aixtron MOCVD 200 RF Tool as shown. Ammonia was purified using either the organo-metal NANOCHEM® OMA™ medium or the new Inorganic NANOCHEM® In2Go™ medium. The figure to the right shows a *noticeable improvement in the Performance Factor with the new In2Go™ medium.*

SIMS analysis indicated that when ammonia was purified by In2Go™ medium, the concentration of oxygen and silicon contaminants in the grown film was typically reduced by *one order of magnitude!* The data suggests that device performance was greatly improved when the silicon concentration was reduced below 1 x 10^{16} atoms / cm^3. A performance factor of 1.5 was attained when the silicon was reduced to 0.5 x 10^{16} atoms/cm^3.

NOTE: Performance Factor = Mobility x Sheet Concentration
OM refers to *organometal* medium – OMA™, IO refers to *inorganic* medium – In2Go™



Purifier Models / Sizes

NANOCHEM® In2GO™ Purification medium is available in a wide variety of hardware configurations for point-of-use, distribution, source and bulk purification applications:

Model	Maximum Flow Rates in N_2 Service	Media Volume	Maximum Allowable Working Pressure#
L-Series	15-150 slpm (0.9-9 NM^3/hr)	300, 500, 2000 ml	500 psig (3.55 MPa)
A-Series*	50-150 slpm (3-9 NM^3/hr)	300, 500, 2000 ml	500 psig (3.55 MPa)
H-Series	50 slpm (3 NM^3/hr)	300, 500 ml	500 psig (3.55 MPa)
HP-Series	50 slpm (3 NM^3/hr)	500 ml	2,850 psig (19.8 MPa)
MS-Series	150-1000 slpm (9-60 NM^3/hr)	4, 8, 16, 32 liters	350 psig (2.51 MPa)
WK-Series*(White Knight™)	60-300 slpm (3.6-18 NM^3/hr)**	500, 2500 ml	500 psig (3.55 MPa)
	1000 slpm (60 NM^3/hr)	9 liters	350 psig (2.51 MPa)

*Drop-in replacement available for competing hardware designs.
**Maximum flow rates will be lower for WK-Series purifiers with built-in poppet valves.
Maximum allowable pressure is 150 psig with the endpoint sensor.
Please contact your local MATHESON Sales Engineer or call 303-678-0700 to obtain a purifier lifetime estimate for your specific operating conditions.

Options

Standard: 0.003 µm particle filter with 99.9999999% retention for ammonia service.
Filter factory-installed on models up to 4-liters capacity and WK-Series; provided in separate package with 8, 16, & 32 liter models (MS Series).***
Manual & Air-Operated Bypass Modules
Endpoint: Available for L-Series, A-Series, H-Series, MS-Series. Not available for HP-Series, WK-Series.

*** **NOTE:** A particulate filter is required for the removal of particulates in the gas

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