



NHX-Plus™ Purification Medium NANOCHEM® Ammonia Gas Purifiers

NHX-Plus™ Regenerable Purification Medium

NHX-Plus™ is an inorganic purification medium that not only removes H₂O, CO₂ and O₂, but also removes hydrogen sulfide (H₂S) and hydride impurities, such as silane, germane and siloxanes. NHX-Plus™ offers the highest lifetimes for the removal of moisture and the best efficiency to remove carbamates (NH₃-CO₂ complexes). NHX-Plus™ has a wide range of applications, including next generation gallium nitride MOCVD processes, and is available in a wide range of purifier sizes: point-of-use to bulk purifiers.

Features and Benefits

- Direct purification of NH₃ used in ultra-high purity applications
- Ideal for GaN and SiN processes
- **Highest Lifetimes**
- **Best Impurity Removal Efficiencies**
- Removes: H₂O, O₂, CO₂, H₂S and dopants: GeH₄, SiH₄, and siloxanes
- Improves and ensures gas purity for process consistency
- Improves process yields & device quality
- No external power source required
- Does not require heating or cooling

Specifications

< 45 ppb H₂O in NH₃ by FTIR, LDL

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 ₂ O in Ar	< 0.3 (LDL)	35	APIMS
H ₂ O in NH ₃	< 45 (LDL)	1000	FTIR
CO ₂ in He	< 11 (LDL)	500	GC-DID
CO ₂ in NH ₃	< 11 (LDL)	25	GC-DID
NH ₄ CO ₂ NH ₂	< 11 (LDL)	50	GC-DID
O ₂ in NH ₃	< 50 (LDL)	100	GC-DID
GeH ₄ in N ₂	< 0.1 (LDL)	2.5	APIMS
GeH ₄ in NH ₃	< 0.5 (LDL)	1	GC-AED
SiH ₄ in N ₂	< 0.1 (LDL)	2.5	APIMS
H ₂ S in He	< 0.3 (LDL)	50	GC-AED
SiH ₄ in NH ₃	< 1 (LDL)	2.5	GC-AED
TEOS (siloxane) in NH ₃	< 40 (LDL)	640	GC-DID

NOTE: Metal emissions from purifier in ammonia service are below LDL, sub-ppb levels (if any) by ICP-MS, GF-AAS

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

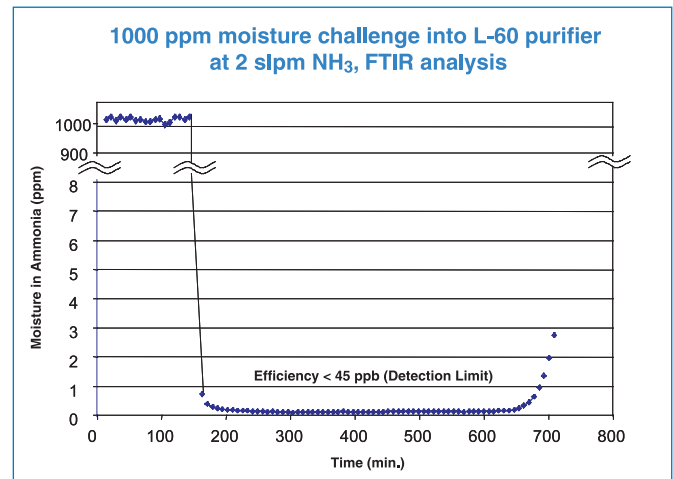
GC-DID Gas Chromatography with Discharge Ionization Detector

GF-AAS Graphite Furnace Atomic Adsorption Spectrometry

ICP-MS Inductively Coupled Plasma with Mass Spectrometry

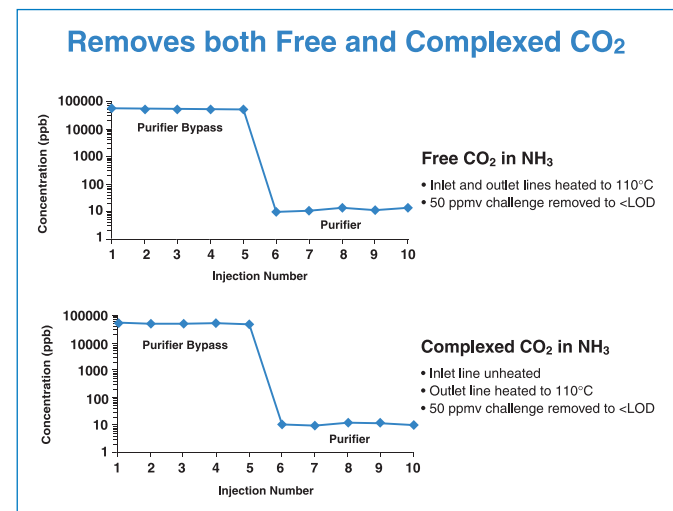
Capacity & Efficiency in NH₃

NHX-Plus™ offers the highest lifetime and the best efficiency for the removal of moisture in ammonia



Removal of Free and Complexed CO₂

NHX-Plus™ offers the best efficiency for the removal of NH₃ - CO₂ complexes. CO₂ is often present in ammonia in the form of complexes, such as carbamates (NH₄CO₂NH₂).



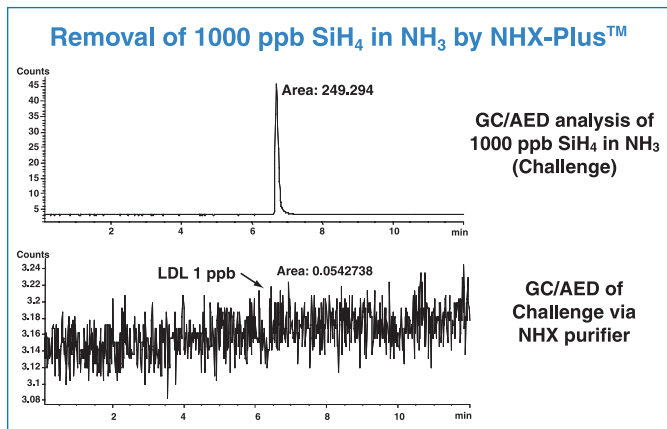
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Dopant Removal

Removal of Silane (SiH₄) in NH₃

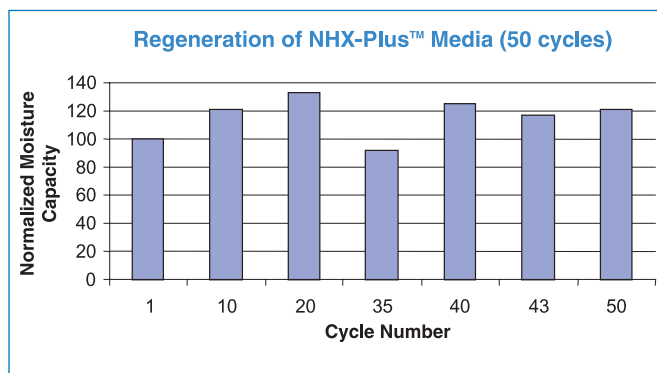
An NHX-Plus™ purifier was exposed to a challenge of 500 ppb silane in ammonia. The silane was completely removed – below the detection limits of ~ 1 ppb, measured by GC-AED. The lower figure (with an expanded scale for the baseline) indicates that the level of residual silane in the purified ammonia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



Regenerability Testing

NHX-Plus™ Cycle Life Test: Moisture Capacity

Shown below is typical capacity data for NHX-Plus™ over fifty (50) regeneration cycles; the capacity and efficiency are essentially unchanged after each regeneration cycle. The material shows no sign of degradation even after 50 cycles.



Purifier Models / Sizes

NANOCHEM NHX-Plus™ 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 NH ₃ 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 slpm (9 NM ³ /hr)	300, 500, 2000 ml	500 psig (3.55 MPa)
C-Series, CL-Series	50-150 slpm (3-9 NM ³ /hr)	300, 500, 2000 ml	500 psig (3.55 MPa)
H-Series	50 slpm (9 NM ³ /hr)	300, 500 ml	500 psig (3.55 MPa)
HP-Series	50 slpm (9 NM ³ /hr)	500 ml	2,850 psig (19.8 MPa)
P-Series	150-250 slpm (9-15 NM ³ /hr)	4, 8, 16, 32 liters	350 psig (2.51 MPa)
MS-Series	250 slpm (15 NM ³ /hr)	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)
	250 slpm (15 NM ³ /hr)	9 liters	350 psig (2.51 MPa)

*Drop-in replacement available for competing hardware designs.

Please contact your local Matheson Tri-Gas, Inc., Sales Engineer or call (215) 648-4000 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 (P & MS Series).**

Manual & Air-Operated Bypass Modules

End-Point Detection = NOT AVAILABLE

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

Equipment Technology Center

166 Keystone Drive
 Montgomeryville, PA 18936
 Tel: 800-828-4313 • Fax: 215-619-0458
 Email: Info@matheson-trigas.com

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Printed in the USA PB022 R01/05



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