

PICO-TRAP™

Ultra-Purification System

PICO-TRAP™ Patent 7,314,506 issued January 1, 2008 to Matheson Tri-Gas, Inc., Vininski, et al.

Increase Productivity and Reduce Defects

Market Requirements

As the semiconductor industry enters the realm of 32 nanometer node processing technology, new enabling manufacturing techniques are entering the marketplace. Leading edge companies are using these new technologies to achieve record-breaking device functionality and complexity as they march along the pathway of Moore's Law. Additionally, existing product lines are pushing the limits of their manufacturing tools for higher throughputs, increased yields and lower defect densities.

The key consideration for these new technologies is to lower the process temperature of the substrate so that further deposition can be achieved without damaging the sensitive layers already on the wafers. By running process conditions at lower temperatures, some of these steps are experiencing higher levels of sensitivity to errant moisture or other volatile impurities than ever before.

Moisture and Volatile Metals

OEM and end users are searching for better ways to keep moisture and other volatile impurities out of critical process gases. The PICO-TRAP™ Ultra-Purification System is designed to address this problem. Through a combination of using Matheson Tri-Gas' NANO-CHEM® purification and by sub-cooling the process gas through a specialized canister, the PICO-TRAP™ system will remove volatile metal impurities and moisture to levels not previously achieved by conventional purification techniques. The PICO-TRAP™ system is designed to be fully regenerable and is flexible enough to operate with a wide variety of specialty gases and tool applications.

A Platform for Other Specialty Gases

By utilizing this technology, Matheson Tri-Gas Electronics Gases and Equipment Groups are currently engaged with the problem facing the semiconductor industry of eliminating the volatile metal impurities and residual moisture from hydrogen chloride (HCl) in advanced epitaxial operations.

In addition to this application, there are many gases, which could benefit from the PICO-TRAP™, each having its own set of purification requirements. A complete list of potential gases has been identified.

Hydrogen Chloride System

The PICO-TRAP™ Ultra-Purification System is the latest in purification technology from Matheson Tri-Gas. This unit complements the use of the NANO-CHEM® inorganic purifier materials and is designed to handle hydrogen chloride purification needs. It will reduce volatile metal impurities to sub ppb levels and moisture to less than 20 ppb, a level that is, to date, unsurpassed by any purifier on the market. Existing purifiers can reduce only moisture down to 100 to 200 ppb.

The PICO-TRAP™ Ultra-Purification System is a self-contained unit with its own ventilated enclosure and PLC controlled operator interface. It has all programming for automatic sequencing through normal operations and for complete regeneration of the system during tool maintenance periods.



PICO-TRAP™ System is comprised of:

PICO-TRAP™ canister
NANO-CHEM® purification
Manual and pneumatic valves to control HCl
Vacuum venturi module
Ventilated all metal gas cabinet
PLC-based control system
Graphical user interface
Refrigeration system



**MATHESON
TRI-GAS**
Electronics

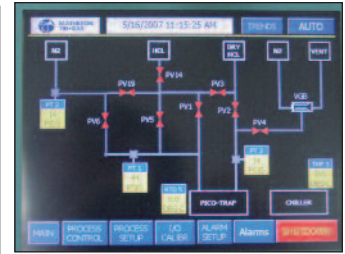
Containment Cabinet

- 12 gauge all welded steel (90" H x 18" W x 24" D)
- 4" exhaust and filtered air inlets
- Self closing door with lock and safety window
- Cabinet exhaust monitors for exhaust and toxic gases
- A liquid spill sensor
- Other typical cabinet facility connections

PLC Control System with Color Touch Screen

The control system of PICO-TRAP™ consists of a PLC based controller cabinet with a pneumatic solenoid bank to sequence process valves as required. The 8 inch full color graphic interface indicates the current program status executed and provides the user with prompts where manual intervention is required.

The retractable tilt screen mechanism is ergonomically designed and meets SEMI S8 standards for operator interface requirements. Located under the self-closing safety glass window, the touch screen panel displays the state of pneumatic valves, pressure signals, chiller I/O and any active alarms.

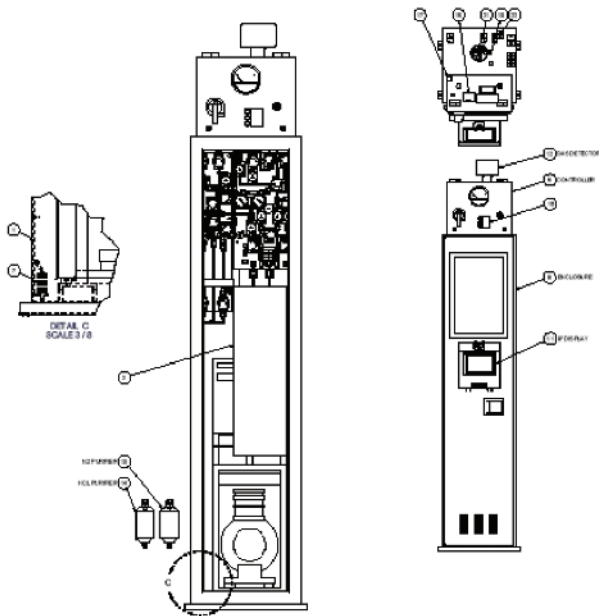


Integrated Refrigeration System (IRS)

The Integrated Refrigeration System (IRS) is a self-contained, recirculating unit that maintains the appropriate temperature of PICO-TRAP™ for each process program. The IRS includes a dedicated control system, which provides an output corresponding to the temperature. Insulated lines connect the circulating fluid to the process control panel. The IRS is controlled by the system's main GUI with the appropriate control and alarm functions available.

PICO-TRAP™ OPERATION

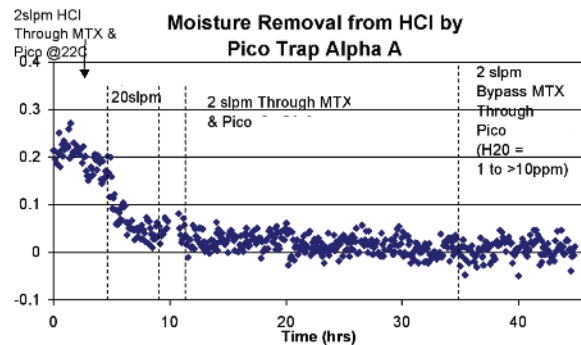
The following information shows how the PICO-TRAP™ is able to remove moisture during lab and beta testing.



Detail of PICO-TRAP™, Gas Panel and Internal Refrigeration Systemsm

PICO-TRAP™ Alpha A

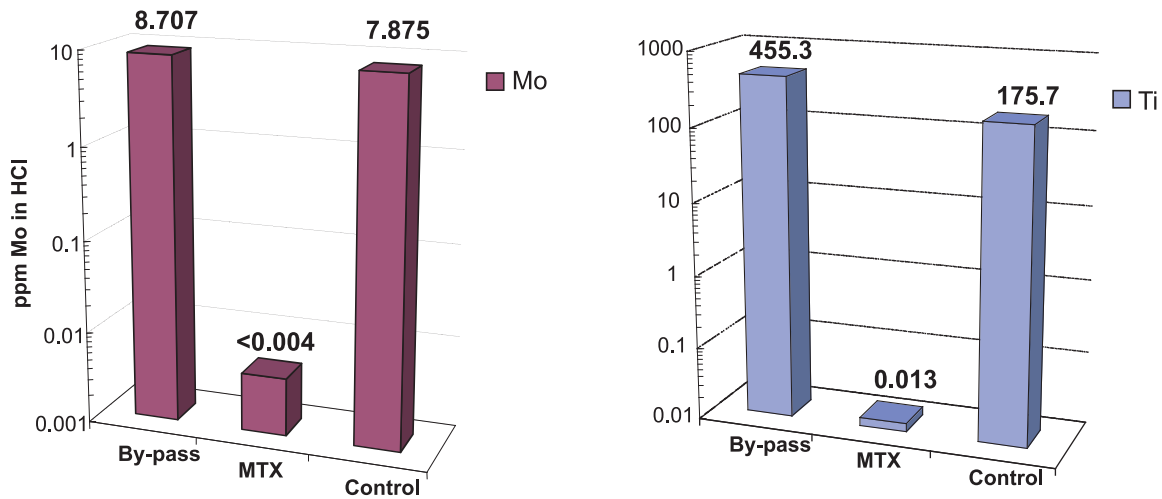
Concept Test 1 – Use at targeted Operating Conditions and METAL-X (MTX) Purification by NANOCHEM®



Metal Reduction in HCL: **NANOCHEM® MetalX™**

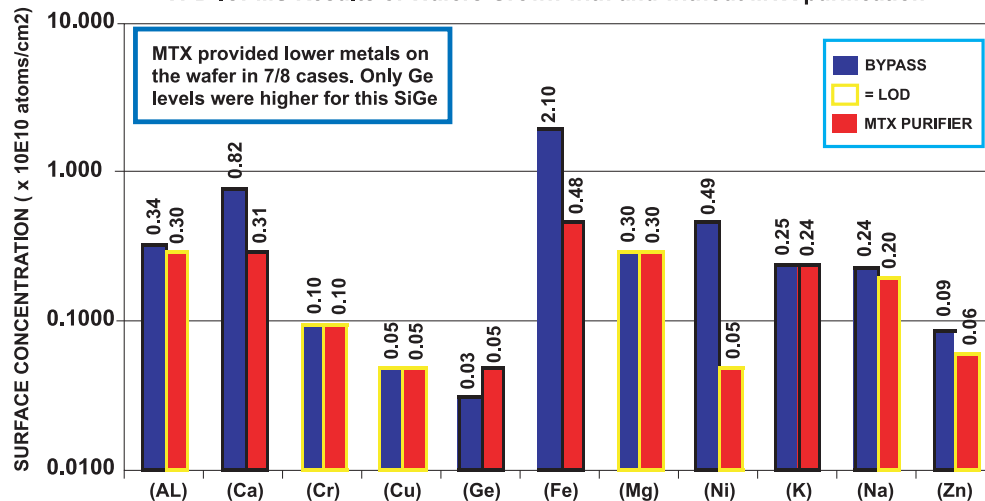
(Doped testing -- Mo / Ti bar charts)

Control = empty purifier w/0.003 µm particle filter



Metal Reduction On Wafer Using **NANOCHEM® MetalX™** (In HCL)

VPD-ICPMS Results of Wafers Grown with and without MTX purification



Operating Specifications

Maximum Flow	50 slpm
Maximum Pressure	45 psig
Pressure drop @ max. flow	6 psi
Purge gas purified by NANOCHEM® Purification	
Inlet Pressure	15 to 50 psig
Flow Rate	15 slpm at during regeneration
Nitrogen for Vacuum Venturi Supply	80-85 psig @ 60 slpm
Power	
Control	220 Vac 5 Amps
Refrigerant System	220 Vac 20 Amp / 3900 W
Nitrogen for Pneumatic Valve Operation	80 psig minimum
Nitrogen for Vacuum Venturi Operaton	60 slpm @ 80 psig
Cabinet Exhaust	300 CFM @ 1"H ₂ O

Note

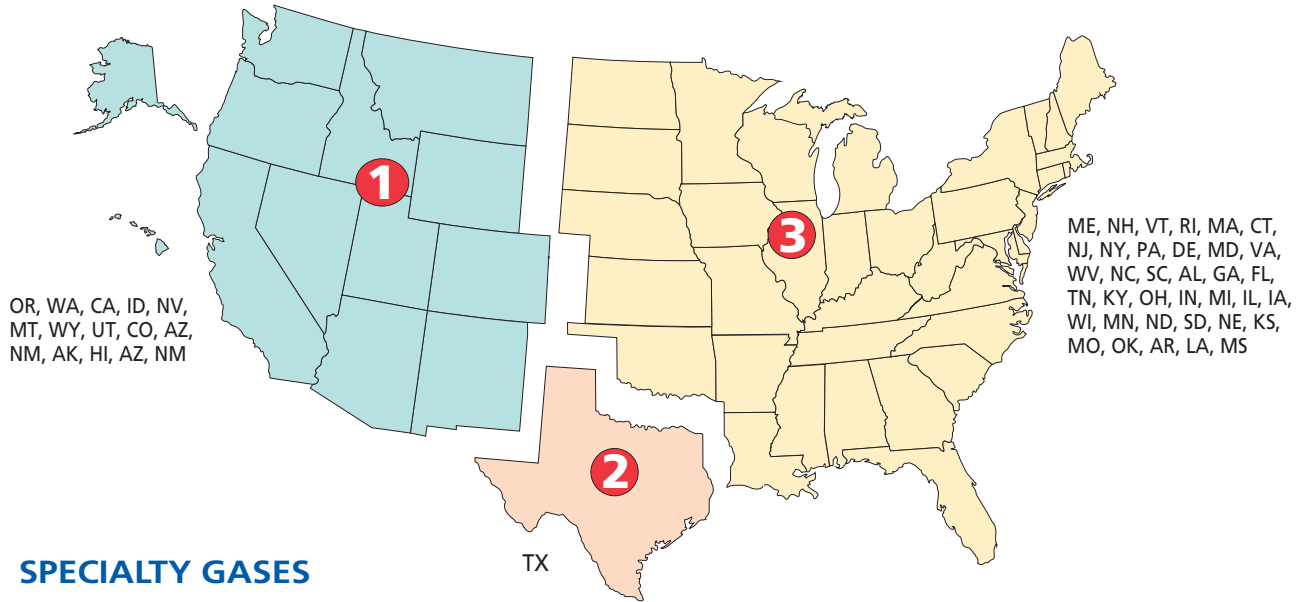
- Ground the power supply and cabinet.
- Use the UPS power supply.
- Gas cabinet exhaust flow rate is based on the condition 4" Duct
- Provide an Emergency Power Shutoff switch for the electric power circuit supplying the controller and all other associated equipment. This switch must be accessible from all typical operating and maintenance workstations, comply with OSHA 29CFR 1910.147, and have lockout/tagout (LOTO) capabilities.



MATHESON TRI•GAS

CUSTOMER SERVICE CENTERS

To place an order, or to obtain more information, please contact our Customer Service Center for your area:



SPECIALTY GASES

1 6775 Central Avenue
Newark, CA 94560
Phone: 510-793-2559
Fax: 510-790-6241
Email: mtgnewark@matheson-trigas.com

2 3106 Pasadena Freeway
Pasadena, TX 77503
Phone: 713-534-8217
Fax: 713-534-8706
Email: mtgpasadena@matheson-trigas.com

San Antonio and Austin area:
2550 Kyle Crossing
Kyle, TX 78640
Phone: 512-262-2129
Fax: 512-262-4011
Email: mtgkyle@matheson-trigas.com

3 166 Keystone Drive
Montgomeryville, PA 18936
Phone: 800-416-2505
Fax: 215-619-0458
Email: info@matheson-trigas.com

INTERNATIONAL

6775 Central Avenue
Newark, CA 94560
Phone: 510-793-2559
Fax: 510-790-6241
Email: mtgexports@matheson-trigas.com

SPECIALTY GAS SYSTEMS AND EQUIPMENT

WORLDWIDE EQUIPMENT TECHNOLOGY CENTER

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

24 HOUR EMERGENCY ASSISTANCE
CHEMTREC Phone: 800-424-9300

MATERIAL SAFETY DATA SHEETS (MSDS)

Data Sheets for gases can be downloaded from the
Matheson Tri-Gas, Inc. Web site at
www.mathesontrigas.com/msds