

PICO-TRAP™ HCl

Ultra-Purification System for Low-Temp EPI

PICO-TRAP™ Patent 7,314,506 issued January 1, 2008 to MATHESON, Vininski, et al.

Process Enabling Technology using MetalX™ and Chilled Process Gas Purification

Market Requirements

As the semiconductor industry enters the realm of 22 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.

New Technology Removes Moisture and Volatile Metals

The PICO-TRAP™ Ultra-Purification System combines the principles of chemisorption and physisorption to remove impurities to levels not achieved by conventional purification. This patented technology gives semiconductor device manufacturers the ability to eliminate impurities that are problematic to process stability and minimizes impurities that are critical to device performance. With applications serving a wide variety of critical process gases, the PICO-TRAP™ system incorporates MATHESON's NANO-CHEM® MetalX™ corrosive gas purification media as a pre-purification step followed by a custom engineered, cryogenic regenerable purification column to deliver the most impurity-free process gas available today.

A Platform for Other Specialty Gases

By utilizing PICO-TRAP™ technology, MATHESON 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 low-temp epitaxial applications.

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 and is available for review with MATHESON's Applied R&D Group. Call or contact us for further information.

Hydrogen Chloride System

The PICO-TRAP™ HCl Ultra-Purification System is the latest in purification technology from MATHESON. PICO-TRAP™ reduces volatile metal impurities by orders of magnitude and moisture to less than 10 ppb.

Actual EPI processing results have been outstanding. Record-breaking results have been achieved for oxygen-free low temperature silicon deposition and hydrogen bake out process steps.

The PICO-TRAP™ HCl 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® MTX™ pre-purification
Manual and pneumatic valves to control HCl
Vacuum venturi module
Ventilated all metal gas cabinet
PLC-based control system
Graphical user interface
External Chiller System

The system is supplied with its own external chiller system to achieve low operating temperature and optimize impurity removal.



MATHESON

ask. . .The Gas Professionals™

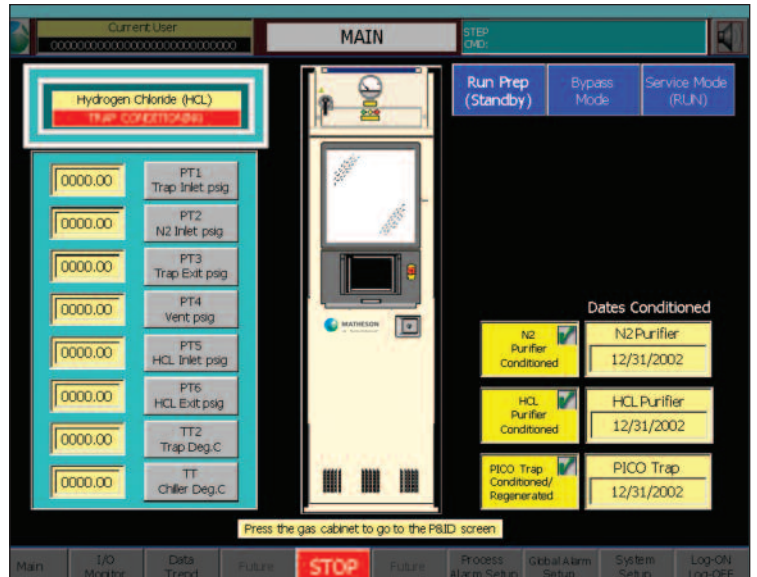
Containment Cabinet (with controller)

- 12 gauge all welded steel (94" H x 25" W x 25" D)
- 6" exhaust and filtered air inlets
- Self closing door with lock and safety window
- Cabinet exhaust monitors for exhaust and toxic gases
- Liquid spill sensor

PLC Control System with Color Touch Screen

The control system of PICO-TRAP™ HCl System consists of a PLC based controller cabinet with a pneumatic solenoid bank to sequence process valves as required. The 12 inch full color graphic interface indicates the current program status executed and provides the user with prompts where manual intervention is required.

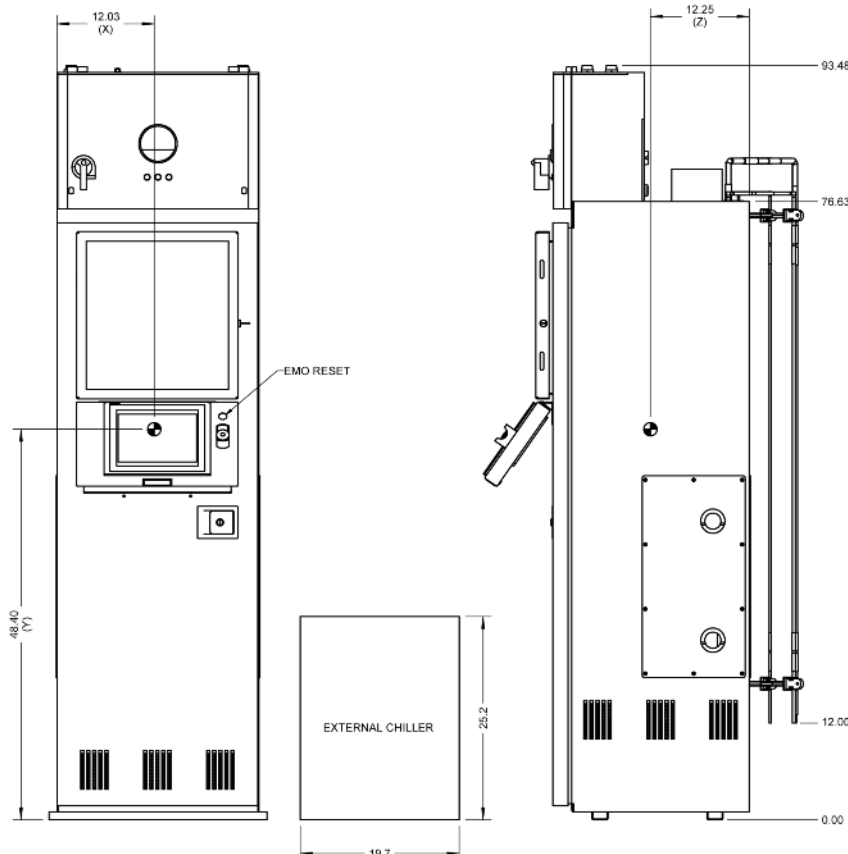
The retractable tilt screen mechanism is ergonomically designed and meets SEMI S8 standards for operator interface requirements. Located under the self-closing safety glass window, the touch screen panel displays the state of pneumatic valves, pressure signals, chiller I/O and any active alarms.



Main Screen

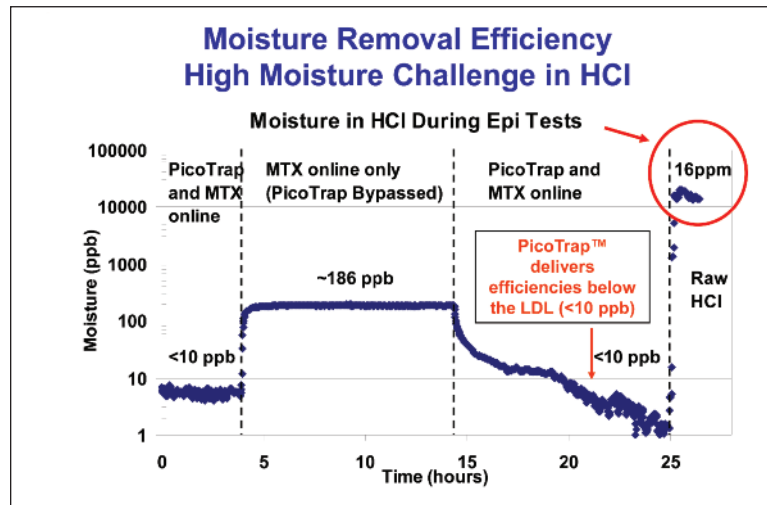
Full color touch HMI with easy-to-use navigation and complete operator instructions.

SEMI - S2 CERTIFIED

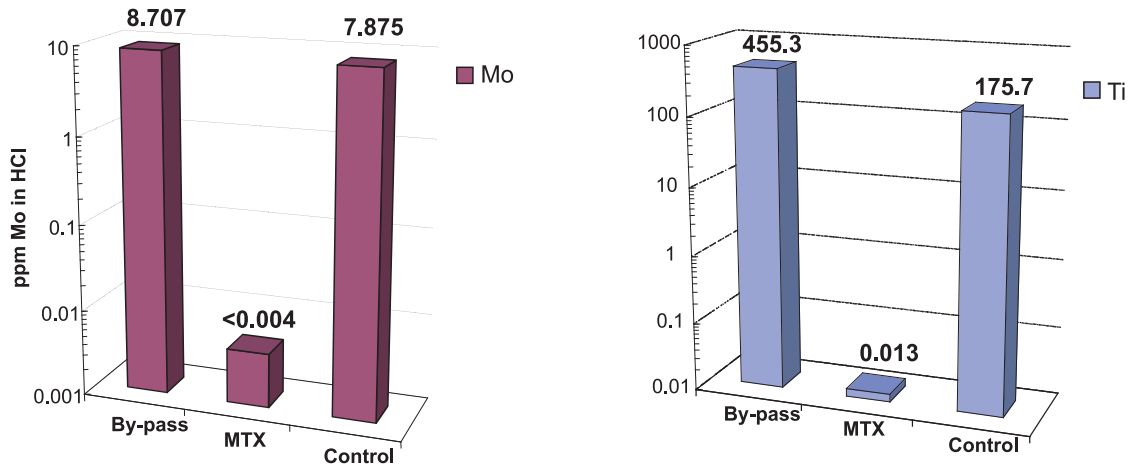


PICO-TRAP™ Operation

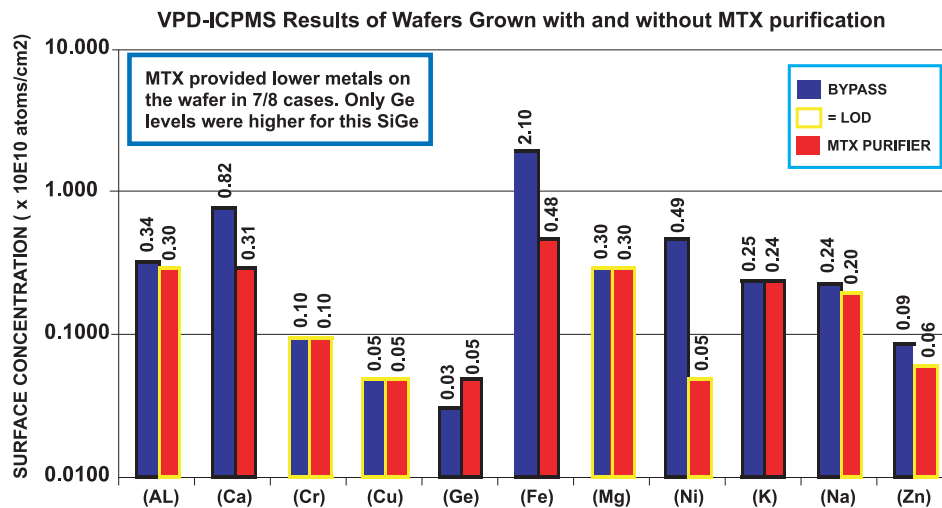
The following graphical information shows how the PICO-TRAP™ is able to remove moisture with volatile metals during laboratory testing and full scale operation.



Metal Reduction in HCl: NANOCHEM® MetaIX™ (Doped testing -- Mo / Ti bar charts) Control = empty purifier w/0.003 µm particle filter

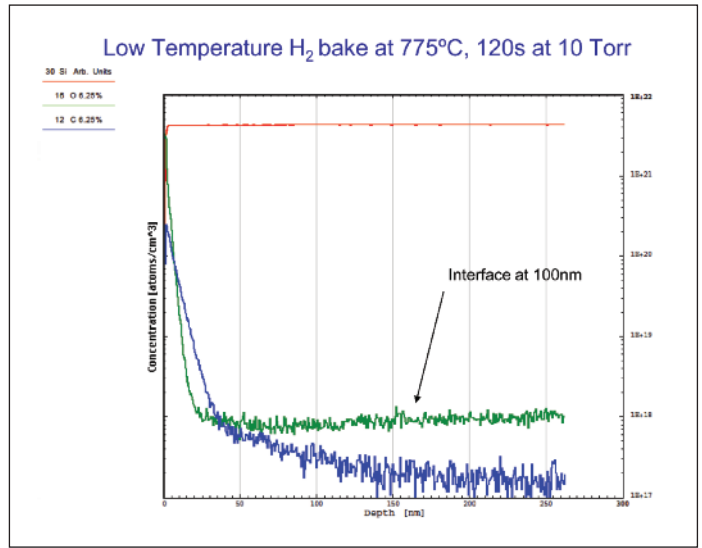
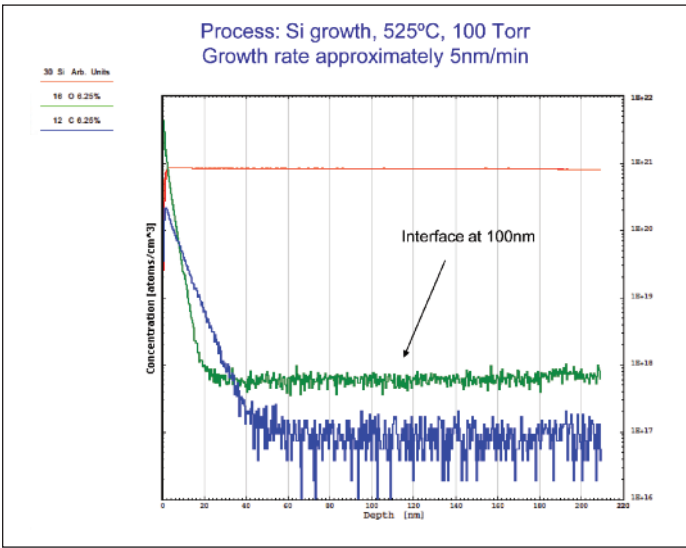


Metal Reduction On Wafer Using NANOCHEM® MetaIX™ (In HCl)



SIMS Data

Actual SIMS data demonstrating oxygen-free silicon growth at 525° C and hydrogen bake operation at 775° C.



Operating Specifications

Maximum Flow	60 slpm
Operating Pressure	90 psig Inlet / 40 psig Outlet **
Purge gas purified by NANO-CHEM® Purification	
Inlet Pressure	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
External Chiller 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

**Pressure regulated to 45 psig max through the PICO-TRAP™ low-temp purification canister.

- Note
- a) Ground power supply and cabinet.
 - b) Use UPS power supply.
 - c) Gas cabinet exhaust flow rate is based on 6 inch duct diameter.
 - d) 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.

Marketing Contact:

Gary Orlando – gorlando@matheson-trigas.com

Specifications are subject to change. Please check www.mathesongas.com for most current information. MATHESON and NANO-CHEM are registered trademarks of Matheson Tri-Gas, Inc. MetalX and PICO-TRAP are trademarks of Matheson Tri-Gas, Inc.



MATHESON

ask . . The Gas Professionals™
www.mathesongas.com