

### Metal Organic Chemical Vapor Deposition







# **MOCVD** Solutions

MATHESON offers Total Solutions Management for MOCVD Applications

- TNSC MOCVD Tools
- ULTIMA<sup>™</sup> Ammonia, Arsine, and Phosphine
- Bulk and On-site Gas
  Production Solutions
- Process and Gas Handling Equipment
- NANOCHEM®
  Purification Systems
- LETV<sup>™</sup> (Liquid Extraction Total Vaporization) NH<sub>3</sub> Bulk Delivery Systems
- Site Services, OEM Configurations and Turnkey Installations
- Specialized Cl<sub>2</sub> Dry Cleaning Systems
- Exhaust Gas Abatement Solutions

MATHESON's parent company, Taiyo Nippon Sanso Corporation (TNSC) was the first in the world to develop MOCVD equipment to produce compound semiconductors used in the liquid crystal displays (LCDs) of such products as mobile phones and car navigation systems, and in blue and white LEDs. This equipment is highly regarded worldwide for its exceptionally stable performance.

MATHESON, as part of the TNSC Group, is uniquely qualified to provide end-to-end solutions for the MOCVD industry. TNSC's world class MOCVD equipment systems are at the heart of the MOCVD solution, and MATHESON combines technology support and supply from TNSC with its own competencies in materials, equipment, and site service to provide comprehensive offerings for specialized customer requirements. These offerings include systems engineering, piping design and installation services, materials and gases, all applicable gas handling equipment, analysis and monitoring systems, specialized Cl<sub>2</sub> dry cleaning system, and purification and exhaust gas abatement solutions. Consequently, the TNSC Group has delivered a large quantity of MOCVD equipment worldwide for numerous applications, ranging from R&D to large systems for mass production.

This unique position allows MATHESON to team effectively with customers to help optimize processes and materials, providing safe, low cost solutions with minimized environmental impact.

Our extensive portfolio of products and services allows us to offer innovative business models that include all necessary elements for successful research, development and manufacturing.

# **TNSC MOCVD Tools**



# **TNSC MOCVD Tools**

The world class TNSC MOCVD tools are highly regarded worldwide for their exceptionally stable operation while offering high performance and productivity to reduce the cost per wafer. TNSC MOCVD tools are available for all needs from research to mass production.

#### **TNSC Reactor Features:**

- Flexible support for various customer needs including MOCVD system configuration, heating system, etc.
- Automated transfer of wafer holder and ceiling plate
- Three-layer laminar flow gas injection
- · Control of wafer temperature distribution by external power input balance
- · Control of AI composition distribution in a bowing wafer
- Only TNSC MOCVD can provide atmospheric pressure growth

#### UR26K

#### GaN MOCVD system for high productivity of 8" wafers

#### Features:

- One of the largest capacity systems for 8" as single reactor
- 1.5 times the productivity compared to the previous model
- Simplified design to minimize downtime

#### Specifications:

- · Reactor Type: Revolution and Rotation susceptor
- Wafer Size: 6"x10, 8"x6
- · Loading/Unloading: Automated
- Heating: 6-zone resistance heater
- Application: Production
- Wafer Face: Face up

#### **UR 25K**

### GaN MOCVD system for high quality mass production of 4" and 6" wafers

#### Features:

- Based on the quality and uniformity-proven reactor of the SR series with atmospheric pressure growth
- Automated parts handling system for the highest productivity
- · Lowest cost of ownership by high-growth rate epitaxy
- Highest throughput with the lowest downtime with  ${\rm Cl_2}\,{\rm dry}$  cleaning equipment

#### **Specifications:**

- · Reactor Type: Revolution and Rotation susceptor
- Wafer Size: 4"x10, 6"x7
- · Loading/Unloading: Automated
- · Heating: 6-zone resistance heater





**UR25** 

# **TNSC MOCVD Tools**

#### SR4000 Series

High Performance GaN MOCVD system for research, development and production use

#### Features:

- Device applications: High-efficiency UV-LED, HEMT, HBT, etc.
- Wide process window based on atmospheric pressure growth
- Longer intervals between maintenance due to optimized gas flow inside the flow channel
- Improved substrate heater properties (temperature uniformity, and heat response)
- · Reduced TAT from development to production
- High temperature option (HT) and simple structure option for R&D (RR) are available

#### Specifications:

- · Reactor Type: Horizontal rotary susceptor
- Reactor Material: Stainless Steel
- Wafer Size: 2"x3, 4"x1
- Wafer Face: Face up

Transfer Tray Material: Quartz





GaAs, IIIr							
Model	Туре	Wafer Face	Wafer Size	Application			
VR-3000	Vertical	Face up	3"x 1 wafer	Research			
HR-3000	Horizontal	Face up	3"x 1 wafer	Research, Development			
HR-4000	Horizontal	Face up	2"x 3 wafers	Development, Production			
HR-6000	Horizontal	Face down	2"x 6 / 3"x 3 wafers	Development, Production			
HR-8000	Horizontal	Face down	3"x 6 / 2"x 18 / 4"x 4 wafers	Development, Production			
HR-10000	Horizontal	Face down	4"x 5 / 3"x 10 wafers	Production			
BMC	Rotation & Revolution	Face down	2"x 42 ~ 6"x 6 wafers	Production			

#### GaN

Model	Туре	Wafer Face	Wafer Size	Application
SR-2000	Horizontal	Face up	2"x 1 wafer	Research
SR-4000	Horizontal	Face up	2"x 3 / 4"x1 wafers	Development, Production
SR-6000	Horizontal	Face up	2"x 6 / 3"x 3 / 6"x 1 wafers	Development, Production
UR25K	Rotation & Revolution	Face up	4"x 11 / 6"x 7 wafers	Production
UR26K	Rotation & Revolution	Face up	6"x 10 / 8"x 6 wafers	Production

\*Customized MOCVD design/manufacturing to customer specification available upon request.

## **Products and Services Offered**

#### Specialized Cl<sub>2</sub> Dry Cleaning Systems

 Your production efficiency can be reduced as a result of nitride film deposits left on the reactor parts of MOCVD tools used in the production of nitride semiconductors for light emitting diodes (LEDs) and laser diodes (LDs).



• TNSC has developed dry cleaning equipment (DEX Series) to remove the nitride deposit on the reactor parts with chlorine gas. TNSC has obtained etching rates at 750° of 75  $\mu$ m/h for GaN and more than 5.7  $\mu$ m/h for Al<sub>0.1</sub>Ga<sub>0.9</sub>N.

#### **Ultra High Purity Gases**

 MATHESON understands the needs of the MOCVD Industry, and we know that every cylinder of gas must have consistent high purity. That's why we have built new state-of-the art plants specifically to produce the highest quality ammonia, arsine and phosphine in the world using the most advanced manufacturing and analytical processes. Our ULTIMA<sup>™</sup> grade offers superior

product consistency and delivers 99.9999+% purity.

#### **Purification Systems for Process Gases**

• MATHESON NANOCHEM<sup>®</sup> purifiers have led the semiconductor industry in state-of-the-art gas purification technologies since the early 1980's. Integrating NANOCHEM<sup>®</sup> purifiers into your gas delivery system can provide process consistency, increased yields, longer equipment lifetimes and

improved overall equipment efficiency (OEE).

 NANOCHEM<sup>®</sup> purifiers are available for over 35 different specialty and bulk gases, and hardware for flow rates from <1 to 1,000 slpm. NANOCHEM<sup>®</sup> purifiers offer the best impurity removal efficiencies, longest lifetimes and endpoint detection.

#### Liquid Extraction Total Vaporization (LETV™) System

 MATHESON's best-inclass ultra high purity ammonia equipment set is tailored to gallium nitride LED processes.
 MATHESON's Liquid Extraction Total Vaporization (LETV<sup>™</sup>) system adds more value than any other bulk delivery system



available on the market today.

 Through a proprietary process, MATHESON has created a patented technology that significantly reduces the customer's cost of ownership.
 MATHESON's system creates gaseous ammonia with consistent purity regardless of cylinder content or flow rate. It uses virtually the entire cylinder content while gas phase systems require disposal of typically 20 – 30% of the cylinder content.



- ULTIMA-Sorb<sup>™</sup> combines two special materials to optimize the scrubbing capacity and efficiency, while reducing heat generation.
- Designed to chemically remove hydride gases at room temperature without intermittent oxidation steps.
- 3 to 5X greater capacity of carbon-based systems.

### **Products and Services Offered**

#### Site Gas Management

 When it comes to maintaining your MOCVD tool and specialty gas system investment, no one in the industry comes close to providing the service and support of MATHESON. We provide a variety of service agreements ranging from semi-annual equipment evaluations to total on-site management.



Some examples of our

On-Site Management are: maintenance and service of the MOCVD tool, gas and chemical inventory management, analytical monitoring and sampling, just-in-time delivery, optimization of point-of-use purity of gases and chemicals, and disposal of all chemical waste. Each service agreement is customized to your schedule, equipment requirements and application.

#### **Analytical Service and R&D Support**

• At MATHESON we are true believers in the value of joint development projects (JDP) with our key electronics customers. We have over twenty active JDPs with many of our strategic customers. This type of collaboration helps identify and address key customer needs early on to help improve and optimize a customer's product and system performance while improving time-to-market for new products.





Other areas of MATHESON R&D focus around the world include:

- Revolutionary Bulk Delivery Technology
- MOCVD Uptime and Efficiency Improvements
- Wafer Cleaning
- Defect Reduction Techniques
- Point-of-Use and Bulk Gas Purification
- In-situ and Process Analysis
- Channel Engineering and Gate Development

#### Site Service Offerings

#### **Equipment Maintenance:**

- Maintenance and Service of MOCVD Tool
- Maintenance of Gas and Chemical Systems
- New Equipment Installation Support
- Spare Parts Management
- Purifier Maintenance
- Equipment History Reports
- · Parts Stocking

#### Levels of Service:

- Gas Cylinder Change-Out
- Full Time / On-Site
- Part Time / On Demand

#### **Process Gas and Chemical Services:**

- Gas Cylinder Management
- Chemical Management
- Fab Chemical Deliveries
- · Bulk Gas and Chemical System Support
- Emergency Response Team (ERT) Participation
- Real Time Chemical / Gas Error Checking

#### QA/QC:

- Incoming Materials or a Fab-Wide Program
- CofA Verification
- Equipment Installation QA

#### **Inventory Control:**

- JIT Inventory Management
- Incoming Material Handling
- Forecasting
- · Bulk Gas and Chemical Support
- NFPA Categorization

#### Monthly Reporting:

- Gas and Chemical Use Trend Analysis
- Equipment Status
- · Analytical Services and Failure Analysis
- Comparative Analysis
- Uptime

#### **Additional Services:**

- DI Water
- Industrial Waste Treatment (IWT) Operation and Maintenance
- Point-of-Use (POU) Scrubber Maintenance
- Life Safety System (LSS) Support
- Joint Research Programs
- DHS Compliance
- NANOCHEM® Service

### About MATHESON

MATHESON is a single source for industrial, medical, specialty and electronic gases, gas handling equipment, high performance purification systems, engineering and gas management services, and on-site gas generation. Our mission is to deliver innovative solutions for global customer requirements.

MATHESON (founded in 1927) is the largest subsidiary of the Taiyo Nippon Sanso Corporation Group (founded in 1910). Taiyo Nippon Sanso Corporation (TNSC) is the largest supplier of industrial gases in Japan, and one of the five largest suppliers of industrial, specialty, and electronics gases in the world. MATHESON became a subsidiary of TNSC in 1984.

We have an exceptional depth of technology and resources that can come only from a global enterprise.

### **MATHESON** and Safety

MATHESON places the highest value on Safety – every day. We value our safety record, and we've received many industry awards for our safe operations. All of our employees are thoroughly trained on an ongoing basis to deliver MATHESON's safety standards.

#### **MATHESON** and Quality

MATHESON also places the highest value on Quality. Our plants are certified to ISO 9001 standards, and we employ Lean Six Sigma (LSS) principles to measure and improve our quality results on a basis of continuous improvement.

#### **MATHESON** and Sustainability

MATHESON is committed, at all levels, and in all locations, to principles of Sustainability and Corporate Responsibility. Our principles embrace Environmental Sensitivity, Community Support, and Financial Performance. Our aim is to ensure uninterrupted access to our products and services.



Copyright 2016 Matheson Tri-Gas, Inc. All Rights Reserved.

All contents of this document are subject to change without notice and do not represent a commitment on the part of Matheson Tri-Gas, Inc. Every effort is made to ensure the accuracy of this information. However, due to differences in actual and ongoing operational processes and product improvements and revisions, Matheson Tri-Gas, Inc. cannot guarantee the accuracy of this material, nor can it accept responsibility for errors or omissions. This document is intended to serve as a general orientation and cannot be relied upon for a specific operation. No warranties of any nature are extended by the information contained in these copyrighted materials.

All names, products, and services mentioned herein are the trademarks or registered trademarks of their respective organizations and are the sole property of their respective owners. Matheson and the Matheson logo are registered trademarks of Matheson Tri-Gas, Inc.