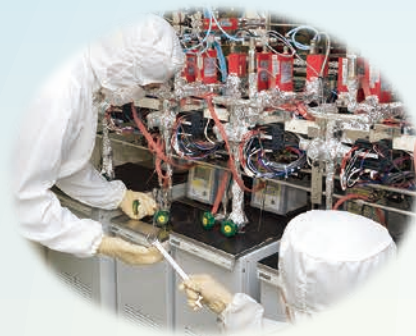
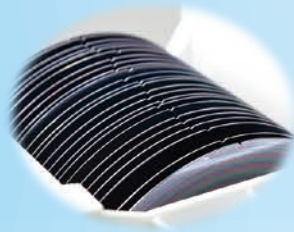




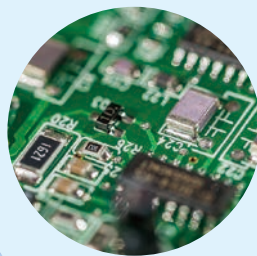
TAIYO NIPPON SANSO CSE
TAIYO NIPPON SANSO GROUP



Contributing to industry and society with the most advanced technologies and as a pioneer in MOCVD equipment

Light Emitting Diodes (LEDs) and smartphones have dramatically enriched society in recent years. Compound semiconductors, with their unique characteristics, are indispensable materials in the core components of these epoch-making devices. Taiyo Nippon Sanso has been a first mover in the development of MOCVD equipment, which is needed in the manufacture of compound semiconductors, and this equipment has received praise for its world-class performance stability.

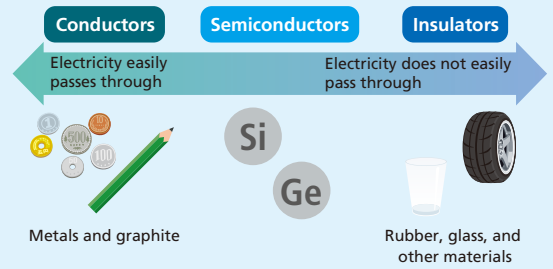
Taiyo Nippon Sanso CSE is a wholly owned subsidiary of Taiyo Nippon Sanso, and we are responsible for the design and manufacture of the MOCVD equipment that our parent company supplies to the world. We intend to capitalize on the advanced engineering technology that we have acquired independently and to contribute to society's future development.



What are semiconductors?

The world contains myriad substances. Among these substances there are those known as “conductors,” which readily allow electricity to pass through, and those known as “insulators,” which inhibit the transfer of electricity. Substances with properties between conductors and insulators are called “semiconductors.”

By combining different chemical elements or changing the quantities of impurities they include, semiconductors can be altered to have different levels of electrical permittivity. The focus given to this trait has led to the broad-ranging use of semiconductors as materials in electronic components.



Note:

Semiconductor integrated circuits (IC), which are a collection of electronic components created using semiconductor materials, are often called “semiconductors” for short. These electronic components are readily confused with the materials of the same name, so it is necessary to pay attention to the differences.

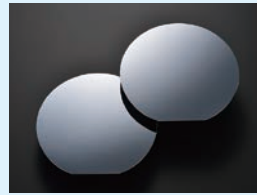


What are compound semiconductors?

Silicon (Si), a well-known semiconductor, has applications in microprocessors, memory, and other semiconductor ICs, but by itself the chemical element Si has functional limitations. Thus, researchers have pursued studies related to creating new compounds that are the product of chemical reactions of two or more elements and that bring together semiconductor properties and high functionality. The result of this research was the creation of compound semiconductors.

Compound semiconductors formed from several elements are next-generation materials that combine various properties, including the ability to change electricity into light, higher electron mobility than silicon semiconductors, and higher breakdown voltage than silicon semiconductors. Currently, these compound semiconductors have applications in a broad spectrum of electronic components, from LEDs and semiconductor lasers to high-speed transistors and high power transistors.

Various compound semiconductor wafers



Gallium arsenide (GaAs) wafer



Gallium nitride (GaN) wafer

What is MOCVD equipment?

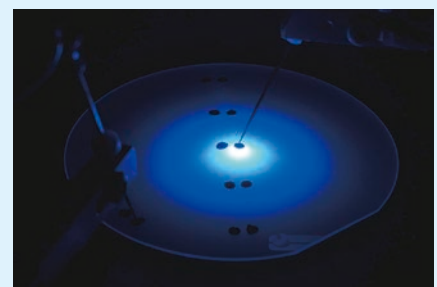
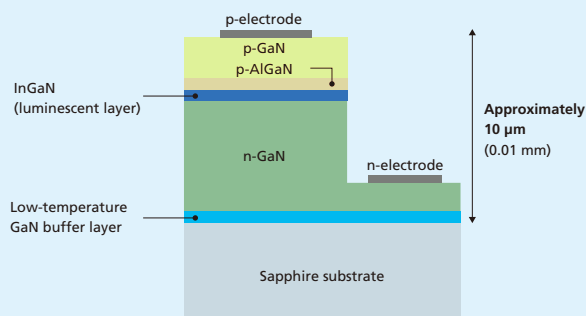
Thin film deposition—forming a thin film of a compound semiconductor on the surface of foundations known as “wafers”—is an indispensable step of the electronic component manufacturing process. By adding layer after layer of compound semiconductors with different properties, manufacturers can create LEDs, transistors, and components with other functions.

This thin film deposition technology is known as “chemical vapor deposition” (CVD), and the Metal-organic Chemical Vapor Deposition (MOCVD) equipment applies thin film deposition using metal-organic materials.



Blue Light-Emitting Diodes (LEDs)

These LEDs are formed through multiple layers of thin films made from different compound semiconductors on a sapphire substrate. The compound semiconductors used include gallium nitride (GaN), aluminum gallium nitride (AlGaN), and indium gallium nitride (InGaN).



Luminescence testing through releasing electrical current into GaN wafers

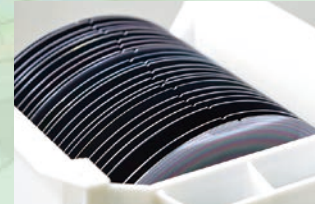
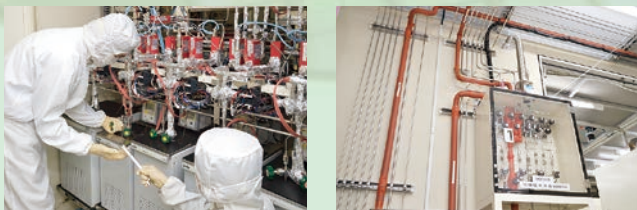


Taiyo Nippon Sanso CSE's MOCVD Equipment

MOCVD equipment consists of a source material supply unit, which precisely introduces the source material to the reactor; a reactor, which deposits the thin films of compound semiconductors on the wafers; an exhaust pressure control unit which controls the pressures within the reactor; and an electric control system, which centrally manages these components. Taiyo Nippon Sanso CSE applies the proprietary gas handling technologies it has cultivated over many years to provide MOCVD equipment that meets our clients' diverse needs.

Source material supply unit

Composed of a thermostatic bath and a gas flow control unit, the source material supply unit converts mainly liquid-based organometallic materials to gas in preparation for supplying this gas to the reactor. In addition to technologies for accurately controlling pressure, gas flow, and temperature, this unit requires advanced pipe welding techniques.



Exhaust pressure control unit

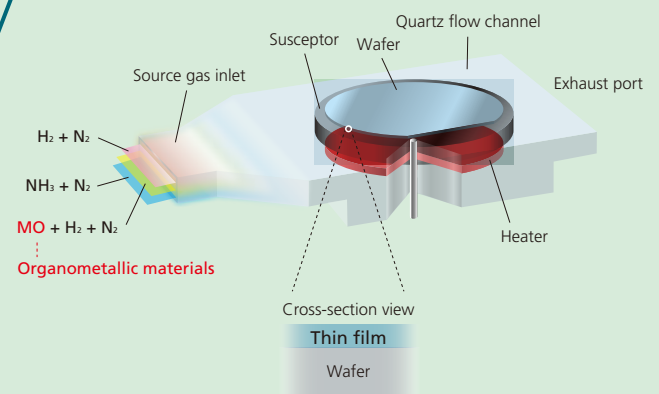
This unit consists of an exhaust pump and a pressure control bulb for accurately controlling the reactor's internal pressure. The filtering unit that captures by-products from the source materials is another vital technology used in this unit.



Reactor

The organic metals and gases that serve as the source materials are fed into the reactor, where they undergo thermal decomposition and chemical reactions. This process then deposits multiple layers of semiconductor film with different electrical and optical properties on semiconductor wafers. Uniformity in the properties of the thin films is the most crucial aspect of wafer production. Therefore, we need to optimize the gas flow and temperature distribution in the reactor. We design temperature and gas flow controls that utilize our advanced proprietary technologies.

For equipment used in mass production, transport robots insert substrate discs into the reactor.

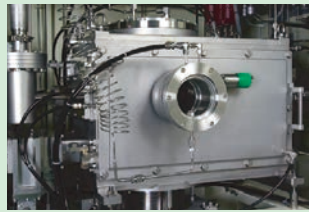


This mass production-oriented equipment can simultaneously load up to six 8-inch (200 mm) diameter wafers. The wafers spin while revolving around the nozzle.



Electric control system

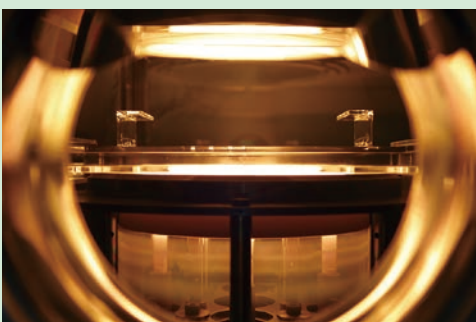
The system consists of a programmable logic controller (PLC) that governs all its components—the gas flow control unit, temperature control unit, manometers, and bulbs—and an input/display unit that connects users with the control programs. Creating programs while calculating how each unit will operate requires advanced technological ability.



Outside of a reactor used in R&D-oriented equipment. The wafers reach temperatures of 1,300 °C inside the reactor, enabling the production of high-quality UV LEDs.



R&D-oriented equipment uses glove boxes for the manual insertion of substrates into the reactor.



Inside of a reactor used in R&D-oriented equipment. When the substrate temperature reaches 1,300 °C, it becomes so bright it should not be viewed with the naked eye.

Equipment production process

Whether designing mechanical components or mapping the piping layout, we find ourselves in many situations that require CAD.



Machined components, in quantities anywhere from several hundred to thousands, are sent to the assembly line after each part undergoes strict inspection.

Assembling the equipment requires mechanical component assembly, piping assembly, electric system assembly, and various other technologies, so in-house experts in all fields work together to assemble the equipment.



We perform deposition tests on all completed equipment before delivering to our clients. Taiyo Nippon Sanso CSE employs engineers who understand process technologies, and they are able to create demo samples at Taiyo Nippon Sanso's Tsukuba Laboratory and evaluate the quality of the deposition process.



In addition to our MOCVD equipment, we also offer special CVD-related equipment, including hydride vapor phase epitaxy (HVPE) systems and dry cleaning equipment.

Taiyo Nippon Sanso: The Gas Professionals

Taiyo Nippon Sanso CSE is a wholly owned subsidiary of Taiyo Nippon Sanso, which boasts the top market share in Japan's industrial gas sector. Since its founding in 1910, Taiyo Nippon Sanso has provided a solid foundation—built on a wealth of experience and its unique technology development capacity—from which to support a wide range of industrial sectors, including steel, chemicals, electronics, automobiles, construction, shipbuilding, and food/beverages. We take pride in our work as industrial gas professionals and actively develop new projects, not only in Japan, but outside the country as well.

Industrial gases

We provide a stable supply of industrial gases to a wide range of industries, including the steel, chemical, electronics, automobile, construction, ship-building, and food industries. We also develop and manufacture gas-applied devices and equipment, and play vital roles in science and environmental preservation.



Gas supply pipelines



Packaged hydrogen station
Hydro Shuttle

Medical Care

We supply synthetic air and medical gases used at medical facilities and provide oxygen supply systems for home-based care, thus contributing to improvements in patient quality of life (QOL). We also offer gas technologies aimed at solving ongoing issues in the field of medical care.



Water-¹⁸O, a stable isotope



Products for home oxygen therapy (HOT)

Electronics

We provide a stable supply of nitrogen and high-purity specialty material gases used in the electronics field. In addition to gas products, we have also developed equipment such as MOCVD production systems, small-scale nitrogen generators, purification systems, and exhaust gas abatement systems. We are uniquely positioned as a total solution provider.



MOCVD equipment



Constructing supply piping for high
purity gases

Plants & Engineering

We have earned considerable trust both in Japan and globally as a manufacturer of air separation plants, space simulation chambers and equipment related to liquid helium.



Large air separation plants



Space simulation chamber

©JAXA

Energy

LP gas is a source of clean energy with a wide range of industry and home uses. We also supply LP gas for heating fuel use, automotive use (such as taxis and other commercial vehicles), and other applications, such as air conditioners and aerosol propellants.



Bulk tank trucks



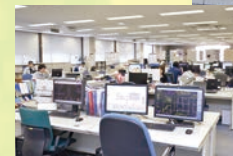
LP gas filling station

Meeting New Possibilities Head-On

Taiyo Nippon Sanso CSE promotes innovation that contributes to the sustainable development of the Taiyo Nippon Sanso Group, while working together with Taiyo Nippon Sanso’s innovation division, development division, and Tsukuba Laboratory. We take advantage of our advanced technological capabilities and our design and production know-how—independently developed over many years of experience in MOCVD equipment design and production—and we strive to break new ground in our business endeavors.



Taiyo Nippon Sanso CSE
at the Taiyo Nippon Sanso
Keihin Plant



TAIYO NIPPON SANSCO
The Gas Professionals



Taiyo Nippon Sanso Shiba Office

This office is the home of the innovation division, serving as the hub for its sales, technology, and design departments. In our attempt to work closely with the development division, we endeavor to round up the latest news on domestic and international markets, while fostering a corporate culture that stimulates abundant creativity, which is essential to innovation.



Taiyo Nippon Sanso Tsukuba Laboratory

This facility is engaged in cutting-edge research on MOCVD equipment, the development of new materials and processes, and other topics related to the electronics field. It also attempts to conduct innovative research and development in the fields of cryogenic air separation technology, stable-isotope compound synthesis, ultrasensitive gas analysis, and ultralow-temperature devices.

Prospective products from the innovation division

Metal 3D printing

Because metal 3D printing allows users to accurately form objects in any shape, it is beginning to see practical use in cutting-edge technologies for the aerospace and medical sectors. The quality of 3D printing heavily depends on atmospheric gas, so Taiyo Nippon Sanso’s gas control technologies should find use in this realm. We are also developing metal powders—source materials for 3D printing—and other related products, while working to optimize post-printing heat treatment processes.



NeoKelvin-Turbo

Superconductor cables and other high-temperature superconductors (HTS) use circulating liquid nitrogen or other coolants to cool their housings. Use the NeoKelvin-Turbo we developed to refrigerate coolants, thereby maintaining temperatures of -200 °C and realizing stable operations for HTSs. Our two devices, with 2 kW and 10 kW cooling capacity, are available for cooling projects of any type or scale.



Firm name	TAIYO NIPPON SANSO CSE LTD.
Address	6-2 Kojimacho, Kawasaki-ku, Kawasaki, Kanagawa (at the TAIYO NIPPON SANSO KEIHIN FACTORY) Tel: +81-44-288-5791
President	Takashi Aida
Founded	February 1, 2008
Capital	30 million yen
Shareholders	TAIYO NIPPON SANSO CORPORATION (wholly owned subsidiary)
Businesses	Design and manufacturing of compound semiconductor fabrication equipment, engineering services, and field services
Certification	ISO 9001



From Kawasaki Station (East Gate)

- By bus
K03 Line from Platform 16
Board the Rinko bus for Ukishima Bus Terminal
Get off at Kojimacho and walk for 5 minutes
*Traveling by bus takes approximately 30 minutes

From Kojimashinden Station

- By taxi, approximately 5 minutes
- On foot, approximately 25 minutes

You can access the Taiyo Nippon Sanso CSE website using the QR code on the right.

<https://www.tncse.tn-sanso.co.jp/en/>

