

## Performance Materials

We will continue to expand the business by actively developing display, semiconductor and inorganic materials, as well as new materials for new fields.

### Display Materials

We continue to develop our display materials business, spearheaded by SUNEVER® polyimide-based LCD alignment coating materials and NHC® insulating hard coating materials, by catering to the growing needs of the display market, particularly in Asia.

### Semiconductor Materials

We provide ARC® (bottom anti-reflective coating materials), OptiStack®\* (multi layer process materials) and temporary bonding materials for 3D package, that are necessary for semiconductor manufacturing processes.

\*OptiStack® is a registered trade mark of Brewer Science, Inc.

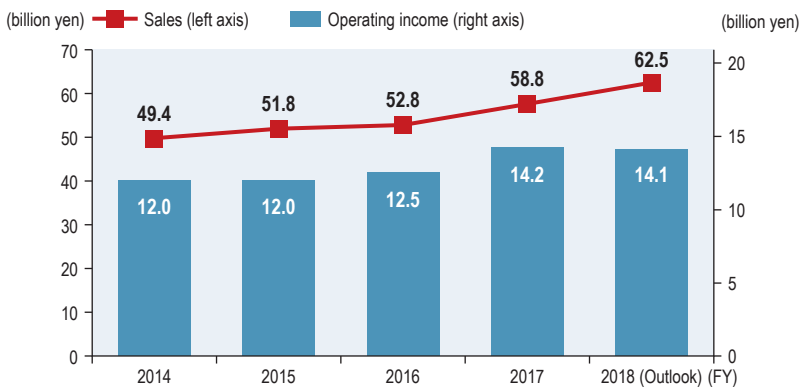
### Inorganic Materials

We have continuously provided nano-colloids, such as SNOWTEX® and organo silica sol, to variety of industries for many years using “Ultrafine Particle Control technology”, one of our core technologies. In these years, we have developed oilfield materials as new field for us.

### New Products

Our development focuses on next generation products that identify the future needs of customers.

## Business Results and Outlook



In FY2017, sales of display materials was strong in SUNEVER® for small to medium size displays, such as smart-phone. For semiconductor materials, sales of ARC® and OptiStack® increased due to the commencement of operations at new factories by some customers and recovery in capacity utilizations. In inorganic materials sales, both SNOWTEX® and organo silica sol / monomer sol performed well.

### TOPICS

#### Establishing Local subsidiary in Suzhou, China

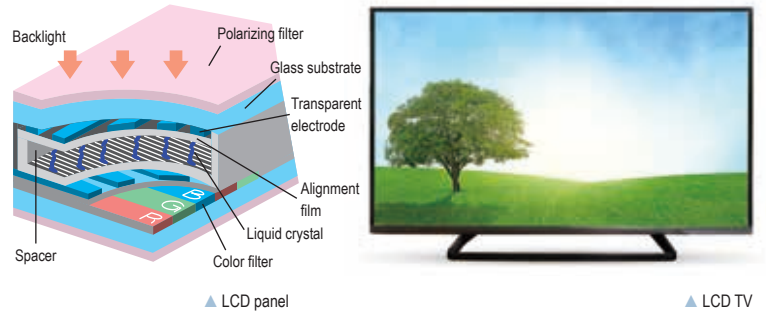
We established Nissan Chemical Materials Research (Suzhou) Co., Ltd. in July 2017 for China display market which is expected to grow in the future. We will strengthen our technical support and customer services, and aggressively develop products that meet market needs, with the aim of further expanding our business.



## Main Products

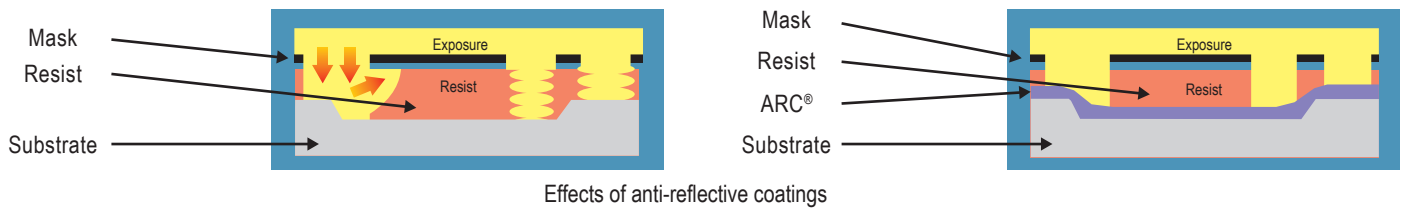
### SUNEVER®

SUNEVER® is a polyimide-based coating for LCD / flat panel displays. It is used to coat the surface of the outer glass panels, to align liquid crystal molecules in a certain direction. We offer various grades of this product for small-and medium-sized screens, such as LCD monitors, PCs, tablets and smartphones, in addition to those for the latest flat-panel LCD TVs.



### ARC® (bottom anti-reflective coating)

ARC® is an anti-reflective coating developed for semiconductor lithography. It is used to coat the part under the photoresist, to resolve a number of issues with lithographic exposure such as reflection from varying substrate levels. This makes it possible to significantly reduce the device failure rate.



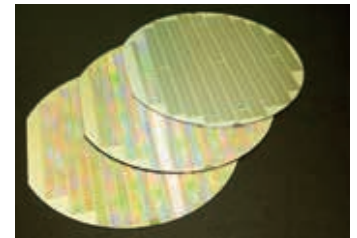
Effects of anti-reflective coatings

### SNOWTEX®, Organo silica sol

SNOWTEX® (colloid solution with nano-sized silica particles dispersed stably in water) and the organo silica sol (colloid solution with nano-sized silica particles dispersed stably in organic solvent) are used in a wide range of fields, including optical film coatings and electronic recording media abrasives. We have also developed monomer sol dispersed in epoxy and methacrylate. It can be used in solvent-free applications.



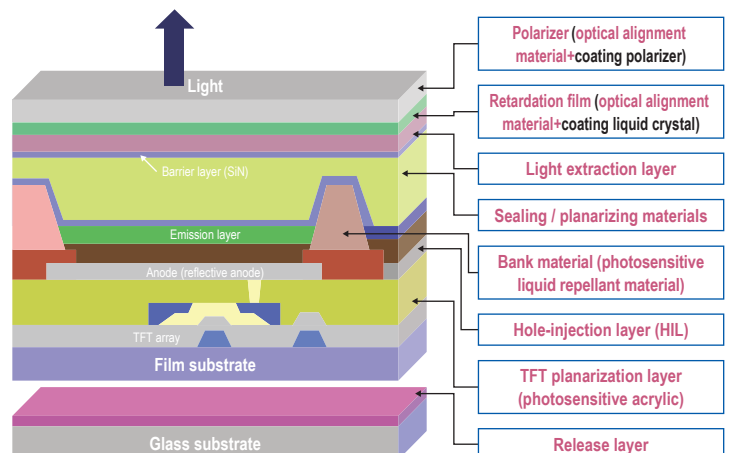
▲ Tablet device



▲ Silicon wafer

### OLED materials

We are focusing on developing markets for OLED, which is expected to grow in the future as a next-generation display. In addition to coating hole-injection layer materials and TFT planarizing film materials, we are currently moving forward with the development of distinctive peripheral materials, including bank materials that help ensure the uniformity of pixels during inkjet application, and optical alignment materials used for anti-reflective retardation films.



## Agricultural Chemicals

Provide a stable supply of food to people around the world. Provide agrochemicals that are environmentally friendly. This is what we aim to do.

We have integrated system from exploratory, research, development to manufacture and sales of new agricultural agents for mainstay crops around the world as well as those in Japan. We also develop agents in collaborative efforts, and actively acquire agents from other companies. We constantly work to expand our product lineup and sell our products in Japan and other countries.

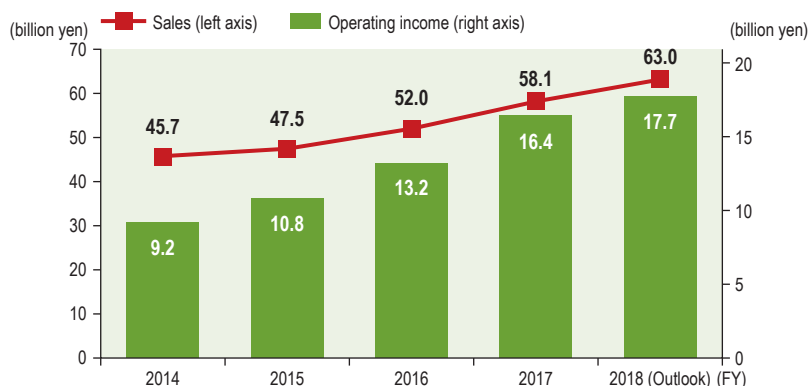
### Agrochemicals

We develop, manufacture, and sell herbicides, insecticides, fungicides, and other products used for the management of agricultural land and green land.

### Veterinary Pharmaceuticals

We develop and manufacture active pharmaceutical ingredients used in ectoparasiticides for companion animals.

## Business Results and Outlook



In FY2017, shipment of Fluralaner expanded and sales of ALTAIR® was strong. ROUNDUP® MAXLOAD contributed to higher revenues by launching new product ROUNDUP® MAXLOAD AL III that is more effective and persistent in weeding than conventional products. In addition, shipments of agrochemicals to overseas markets were strong.

## Main Products

### Herbicide

#### ALTAIR®

ALTAIR®, an active ingredient in herbicides for paddy rice, is a wide-spectrum herbicide that is highly effective in eliminating bulrush and cyperaceous perennial weeds. It is also effective for weeds that are resistant to conventional sulfonylurea-based herbicides. We market this product in Japan, South Korea and China.



▲ ALTAIR®

#### ROUNDUP® MAXLOAD, ROUNDUP® MAXLOAD AL・AL II・AL III

In 2002, we acquired the exclusive marketing rights to this product in Japan from Monsanto. While this herbicide kills most weeds, it has low toxicity to humans and animals and does not remain in the soil or in the environment. In addition to agricultural land, in 2011 we developed a shower-type “AL” that can be used as a household product. In 2016, we added a fast-acting “AL II” and in 2018, we launched “AL III” that is both fast-acting and persistent to address customer needs.



▲ ROUNDUP® MAXLOAD AL・AL II・AL III

## SIRIUS®

To meet the needs of farmers, we develop and sell a large number of one-shot herbicides for paddy rice. The main component of these herbicides is SIRIUS®, our proprietary active ingredient. We have been marketing these products in more than 20 countries for over 20 years.

## TARGA®

This herbicide controls gramineous weeds that affect broadleaf crops such as soy beans, rapeseed, beets, cotton and sunflowers. It is used in more than 40 countries, including India and countries in the United States and Europe.

## PERMIT®

This product has effect against cyperaceous weeds extremely. We market this product in Japan under the trade names of HICUT®, which is a herbicide for paddy rice in the mid to late term that is highly effective against the pesky weed *Eleocharis kuroguwai*, and INPOOL®, for lawns. We also market it as PERMIT® in more than 20 overseas countries as an herbicide for paddy rice, corn fields, sugar cane fields and lawns.

## ■ Insecticide

### STARMITE®

This acaricide prevents and eliminates spider mites from fruits, tea and vegetables. It is extremely safe for the natural enemies of spider mites and useful insects such as honey bees. In South Korea, it is used for fruits and vegetables, and in South America it is used for flowers.

### SANMITE®

This insecticide / acaricide is effective against spider mites and rust mites in fruit trees, as well as spider mites and whiteflies in vegetables. We also market this product in about 30 overseas countries.

## ■ Fungicide

### LEIMAY®, ORACLE®

These fungicides have specific activity for diseases caused by oomycetes and myxomycetes. We sell LEIMAY®, which is used as an atomizing agent for potatoes, grapes and vegetables, and ORACLE®, which is used for preventing and eliminating the root-knot disease of cruciferous vegetables and soil-borne diseases of potatoes, rice, vegetables and lawns. BESGREEN® meanwhile is designed to prevent diseases in lawns, and is sold in domestic and more than 20 overseas countries including Europe, South Korea and China.

### GREATAM®, PULSOR®

These products contain a fungicide that we acquired from Dow AgroSciences in 2010. We market GREATAM® for the sheath blight disease that affects paddy rice and IKARUGA® for large patch disease of lawn. We export and sell this product in overseas markets including China, South Korea, India and Brazil under the trade name of PULSOR®.

## ■ Active Ingredient for Veterinary Pharmaceuticals

### Fluralaner

A compound that we invented in-house, Fluralaner is one of the ingredients contained in BRAVECTO® (veterinary pharmaceuticals), developed by MSD Animal Health. We manufacture Fluralaner and then supply it to MSD Animal Health for use in as active ingredient for veterinary pharmaceuticals.



▲ STARMITE®

▲ LEIMAY®



▲ BRAVECTO®

## TOPICS

### Establishing Nissan Agro Tech India PVT. LTD.

India is world's sixth largest and one of the fastest growing agrochemical markets. Taking account of the market situation, we established a local subsidiary in July 2017 to strengthen sales, marketing, and R&D. We support sales promotion and development of our products with six people.

# Pharmaceuticals

We strive to develop better pharmaceuticals by making use of our cultivated technologies. Our products help preserve precious lives and deliver smiles to people around the world.

## Drug Discovery

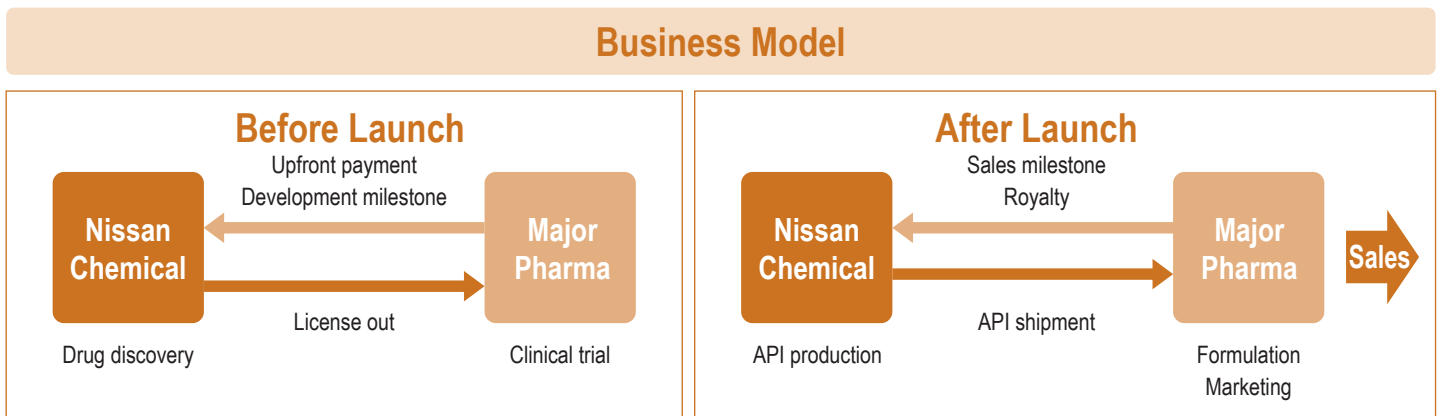
We first entered pharmaceutical business in 1982. Since then, we have continued to deal with challenges in the R&D of innovative new drugs, making full use of our strategically developed chemical compound library, our cutting-edge evaluation functions, and our fine organic synthesis technologies.

## Finetech®

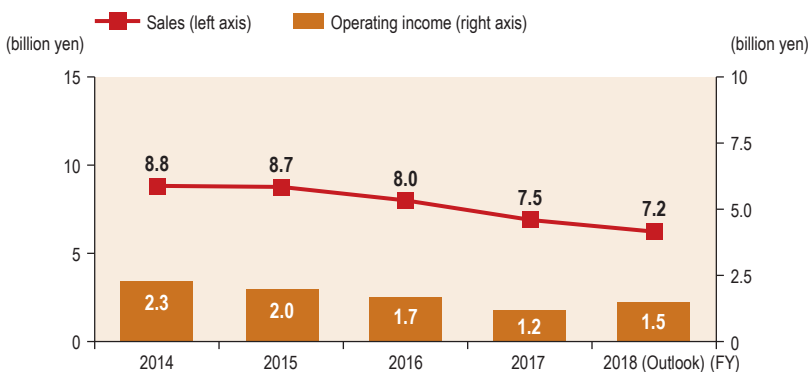
This business provides total support to customers for their R&D of active pharmaceutical ingredients (API). Specifically, we engage in the contracted development of manufacturing process in each one of the stages from pre-clinical to commercial production, as well as the contracted manufacture of API and intermediates in compliance with GMP.

## Features of Our Business

A Unique Business Model that Specializes in New Drug Discovery and the Manufacture of API without a Sales Force



## Business Results and Outlook



In FY2017, sales of API of LIVALO® to overseas markets increased, but sales to domestic market decreased due to an increase in sales of generics. On the other hand, Finetech® posted strong sales.

## Main Products

### Pitavastatin calcium (LIVALO®)

This is a statin agent that greatly reduces LDL cholesterol and causes fewer drug-interactions, offering the advantage of safety. This agent is recognized as one of the “strong statins” in clinical practice, and it is distributed by Kowa Pharmaceutical Co. Ltd. in Japan. It has also been released in the United States, as well as Latin American, European, and Asian countries. There are plans to release it in other countries and territories in the future.

### Efonidipine hydrochloride (LANDEL®, FINTE®)

This is a dual type Calcium antagonist that blocks not only L-type calcium channels, but also T-type channels. This agent has shown to have a positive effect on hypertension and angina pectoris. In addition, the agent is expected to provide a renal-protective and cardio-protective benefits. LANDEL® is distributed by Zeria Pharmaceutical Co., Ltd. and Shionogi & Co., Ltd. in Japan, and FINTE® is distributed by Green Cross Co. in South Korea.

## Novel Agent under Development

### NIP-022 (thrombocytopenia treatment agent)

This activates the thrombopoietin receptor, which is a hematopoietic factor. This is orally administrable drug and enables to accelerate platelet production. It has the potential to be a drug for treating every kind of thrombocytopenia.

### NTC-801 (anti-arrhythmic agent)

This is an orally administrable antiarrhythmic agent that inhibits the acetylcholine-activated potassium channel current (IKACH). NTC-801 is expected to be used as an atrial selective agent for the treatment of atrial fibrillation because IKACH channels are apparent in the atrium but not in the ventricle.



▲ Compound library at Biological Research Laboratories

## Finetech® Business

### Manufacturing API and intermediates (from pre-clinical to commercial production stages, including manufacturing in compliance with GMP)

We manufacture API and intermediates by establishing manufacturing methods that can be scaled up.

### Process research (route scouting, optimization and scale-up)

We establish production processes that can be scaled-up through quantitative reaction analysis and confirming the stability data of every process. We suggest cost-competitive synthesis routes by only disclosing the structural formula.

### Supplying API of generics

We develop and sell API capable of high levels of activity in small amounts, such as the prostaglandin (PG) class of ingredients and vitamin D<sub>3</sub> (VD<sub>3</sub>), by making use of our cultivated technologies for handling high active API and our column equipment capable of high levels of refinement.



▲ Finetech® development plant

## TOPICS

### Challenges in manufacturing API of constrained peptides

We invested 900 million yen in a third-party allocation of shares of PeptiStar Inc., which is aiming to establish a stable supply system for API of constrained peptides. In the future, we will work with PeptiStar Inc., to accelerate R&D on new liquid-phase methods of constrained peptides in which are expected to reduce pharmaceutical manufacturing costs, and expand our contracted manufacturing and process researching services of pharmaceuticals.

# Chemicals

The development of products focused on high-level customer needs is another important mission.

## Basic Chemicals

We provide products to meet a wide range of demands, focusing on melamine, sulfuric acid, nitric acid, ammonia and other industrial chemicals. We also provide high purity chemicals for washing semiconductors.

## Fine Chemicals

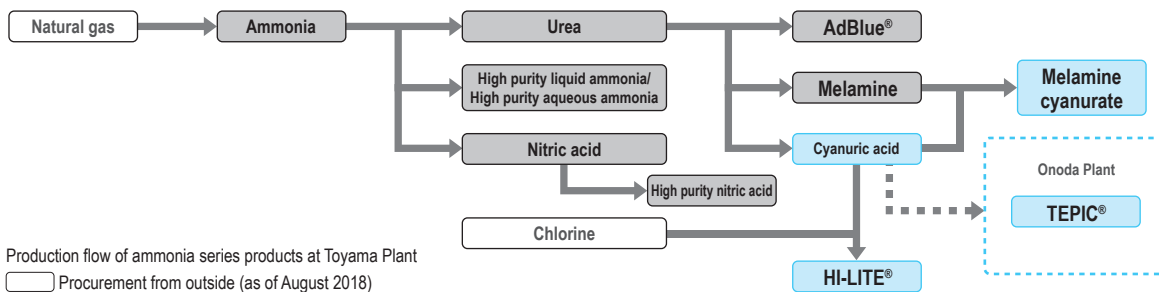
This business focuses on environmental chemicals such as TEPIC® (a special epoxy compound for sealants), melamine cyanurate and PHOSMEL® (non-halogen flame retardants), phenylphosphonic acid (a surface modifier), and HI-LITE® (sterilizing agent and disinfectant).

## New Products

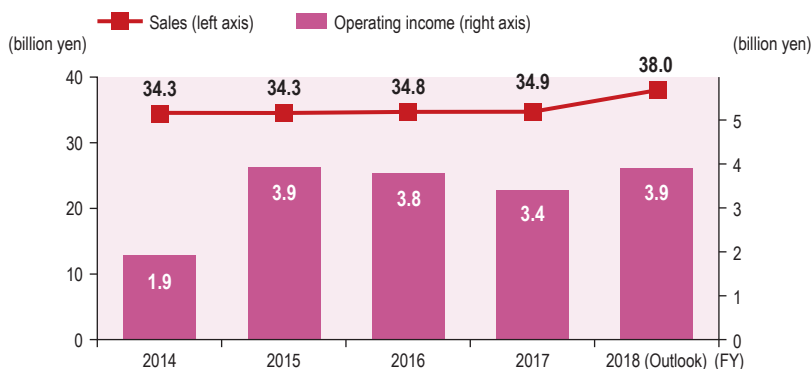
To better meet customer needs, we are working to fully enhance our product lineup, which focuses on new grade TEPIC®.

## Features of Our Business

### Supplying Derivatives that Use Ammonia as Main Raw Material



## Business Results and Outlook



In FY2017, sales of melamine decreased and sales of high-purity sulfuric acid increased in basic chemicals. In fine chemicals, shipment of TEPIC® was strong, while sales of HI-LITE® decreased. Profit margins for the entire business also declined due to higher fuel and feedstock prices.

## Main Products

### Melamine

This is widely used as an adhesive agent for plywood, laminated sheets, molded products, resin finish for fabric and paper, and paint. It is highly aesthetic and offers a substantial level of quality.

### High purity chemicals

Our products used for semiconductors / LED require an extremely high level of purity. We provide sulfuric acid, nitric acid, and ammonia to customers, who hold our products in high regard.

### AdBlue® (High-grade urea solution)

This is a solution of urea in demineralized water used as an operating fluid in diesel-powered freight trucks to purify emissions. We have established and expanded our original supply system addressing customer needs.

### FINEOXOCOL®

This is our unique, highly branched and saturated fatty alcohols and acids product with a long chain alkyl group consisting of carbon 16 to 20. It has been used for various esters, lubricants, cosmetics, and ink modifiers.

### TEPIC®

This tris (2, 3-Epoxy propyl) isocyanurate is a special tri-functional epoxy compound consisting of a triazine ring and three glycidyl groups. The triazine ring provides excellent outdoor durability due to its low UV absorption, while the glycidyl groups provide outstanding heat resistance by densely cross-linking with resins.

### Melamine cyanurate (MC)

This is a compound of melamine and isocyanuric acid. We provide a high quality product by integrating production from raw materials. MC is highly nitrogen containing compound, which offers superb thermal stability up to 300°C. It is used as a flame retardant or an auxiliary flame retardant for various engineering plastics such as nylon resins. It also exhibits outstanding flame retardation when used with flame retardants such as phosphorus systems or metal hydroxide, and has been added to various plastics.

### HI-LITE®

Chlorinated isocyanurate is the main ingredient in this product, which is used for sterilization and disinfection of swimming pools and water purification tanks, and thus contributing to public hygiene.

### Nissan Reishi

Nissan Reishi is a safe Japanese-made health food created through the domestic processing of Reishi mushrooms grown in Japan.



▲ Plywood



▲ LED



▲ AdBlue® truck



▲ HI-LITE® in use



▲ Reishi



## Advanced Materials & Planning

Tackling challenges in new fields with an “undaunted spirit”

Our mission is to create new materials and businesses that will be our pillars for future growth of performance materials and life sciences business. We work on developing new materials that meet market needs by making full use of our core technologies, “Fine Organic Synthesis”, “Functional Polymer Design”, “Ultrafine Particle Control”, “Biological Evaluation” and “Optical Control”. We also promote collaboration between industry, government, and academia, such as alliances with distinguished companies and joint research with universities, to generate actual demand at an early stage.

## Main and New Products

### Life Science Materials

#### FCeM® series

FCeM® series are the base materials for three dimensional cell cultures and enable to prepare the cells efficiently and extensively. Preparation Kit can cultivate large amounts of iPS / ES cells by floating cultures of cells in three dimensional state. Cellhesion® enables mass culture of these cells as a scaffold for vaccines and antibody-producing cells and mesenchymal stem cells.



▲ Preparation Kit



▲ Cellhesion®

#### NANOFIBER GEL®

This is an additive for cosmetics and topical agents that is friendly to people and the environment, consisting of fatty acids and amino acids. It can be used in most cosmetic items. By adding to the active ingredients, the moisturizing effect and the permeation promotion effect are achieved. In addition, this product is available to promote protection effect for hair and skin.



▲ Spray



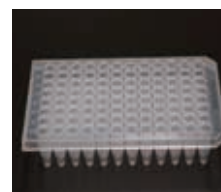
▲ Shampoo



▲ Foundation

#### prevelex® (Material for preventing the adhesion of biomolecules)

Applicable from experiments and research to regenerative medicine, prevelex® is an ultra-thin film material with nanometer-level thickness which allows the easy coating of objects of various shapes. It can be coated on PP, COP and PDMS that had been difficult to coat. We are promoting the development of customers in the medical equipment field by taking advantage of its characteristics to prevent the adhesion of biomaterials such as exosome, as well as cell adhesion and protein adsorption.



▲ Consumables for pharmaceutical research

#### AQUAJOINT®

AQUAJOINT® is a two-liquid, room temperature solidified, elastic hydrogel. By merely mixing the two aqueous solutions and allowing them to stand at room temperature, water-soluble components form a three-dimensional network and gel. These aqueous solutions with additive can make mold and can be formulated as customer needs.



▲ AQUAJOINT®

## Environmental Harmony Materials

### ECOPROMOTE® (crystal nucleating agent for polylactate)

This forms a stable crystal nucleus during the polylactate molding process to significantly increase the speed of crystallization. It produces fine, even crystals, helping to improve the molding cycle and enhance the heat resistance and transparency of molded products.



▲ Bioplastic products (illustration purposes only)

## Optical Materials

### SUNCONNECT®

This is liquid organic-inorganic hybrid resin materials that exhibit high thermal stability and near-infrared transparency. Suitable for imprinting methods, photo lithography and other processes. It is used for optical interconnects for purposes such as optical waveguides and lenses for optical connectors.

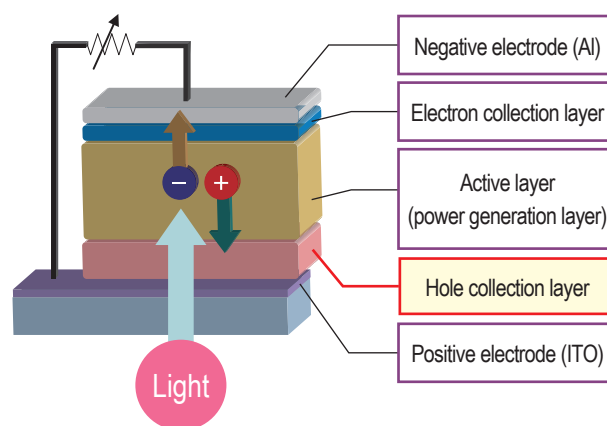


▲ Optical printed circuit board (illustration purposes only)

## Battery Materials

### Organic Thin-film Solar Cell Material

We are developing the hole collection layer of organic thin-film solar cells. The hole collection layer collects holes from excitons generated in the active layer and then transports them to the cathode. At the same time, it blocks the inflow of electrons. It plays an important role in improving power generation efficiency. We will accelerate market development by taking advantage of the features of this material, such as the capability of forming highly flat thin film, preparation at the HOMO level, and compatibility with various printing methods.



▲ Example for Organic Thin-film Solar Cell

### FairCurrent®

FairCurrent® is undercoat material for lithium-ion batteries (LiB) containing highly dispersed nanomaterial. The thin film of FairCurrent® coated on current electrode enables LiB to improve energy density and life by reduction of electric resistance and increasing adhesion to electrode, and applicable for the automotive LiB.



▲ Electric vehicle

## Research and Development

We strive to further refine the core technology we have cultivated throughout our long history, and develop new products, technologies, and businesses.

### Chemical Research Laboratories

Chemical Research Laboratories is Nissan Chemical's core R&D site, and is responsible for our corporate research. It researches and develops agrochemicals and pharmaceuticals that utilize the fine organic synthesis technology we have cultivated over the years, research on company-wide processes, and material analysis research.

#### Major research contents

- Discovery of agrochemicals and pharmaceuticals, and the development of agrochemical formulations and active pharmaceutical ingredients
- Development of new organic materials and polymer materials
- Process development of new products and candidates
- Material analysis and computational science that support research



▲ Funabashi, Chiba

### Materials Research Laboratories

Materials Research Laboratories creates highly unique new materials, allowing us to respond quickly to increasingly sophisticated and diverse market needs. At the same time, the Laboratories focuses their efforts on researching next-generation materials in an effort to create new markets.

#### Major research contents

- Material development based on technologies for the design, synthesis, and evaluation of functional polymers and composite materials
- Development of new materials intended for new display technologies and semiconductor process technologies
- Manufacturing research and the application development of materials such as inorganic particulates



▲ Funabashi, Chiba



▲ Sodegaura, Chiba



▲ Toyama, Toyama

### Biological Research Laboratories

Biological Research Laboratories serves as a place for life science research, such as evaluation research related to the usefulness and safety of agrochemicals, pharmaceuticals and medical materials.

#### Major research contents

- Efficacy tests, safety tests, and residue tests of agrochemicals in greenhouses and on farmland
- Pharmacological tests, safety tests and pharmacokinetics tests of pharmaceuticals, ranging from those on the gene level to those based on pathological models
- Development of medical materials such as cell culture media, stem cell amplifiers, and coating materials for medical equipment

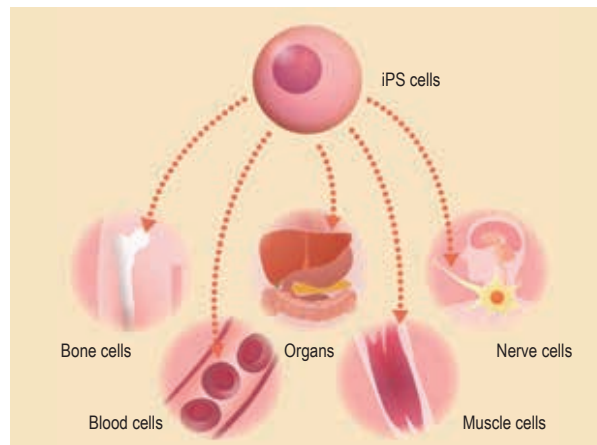


▲ Shiraoka, Saitama

## Promotion of Industry-Government-Academia Collaborations

While we deepen our proprietary technologies, we also promote the creation of new materials and introduction of new technologies through industry-government-academia collaborations. As part of these activities, we are participating in a project of the Japan Agency for Medical Research and Development (AMED), which was founded in April 2015, and are working on the development of a cell manufacturing and processing system for the industrialization of regenerative medicine. We are conducting joint development with Kyoto University, and have discovered a technology that leads to the low-cost manufacturing of iPS cells. We will continue to contribute to the development of regenerative medicine while also proceeding with state-of-the-art research.

In addition, as an industry-academia collaboration, we have set up a laboratory in FiaS (Fukuoka Industry-Academia Symphoncity) since September 2008 as a base for introducing materials seeds and cutting-edge technologies at Kyushu University.



▲ Regenerative medicine (illustration purposes only)

### TOPICS

Since FY2017, we have been participating in projects in NARO (National Agriculture and Food Research Organization), and are researching efficient agrochemical manufacturing processes using flow reactors that can carry out chemical reactions in fluids.



▲ Fukuoka Industry-Academia Symphoncity

## R&D Expenses

We consider R&D is the source of growth, and have intensively invested our management resources in R&D.

Over the last five years, R&D expenses have totaled 78.3 billion yen. The percentage of our expenses in Performance Materials and Life Sciences (Agricultural Chemicals and Pharmaceuticals) is accounting for 47% and 40% respectively.

