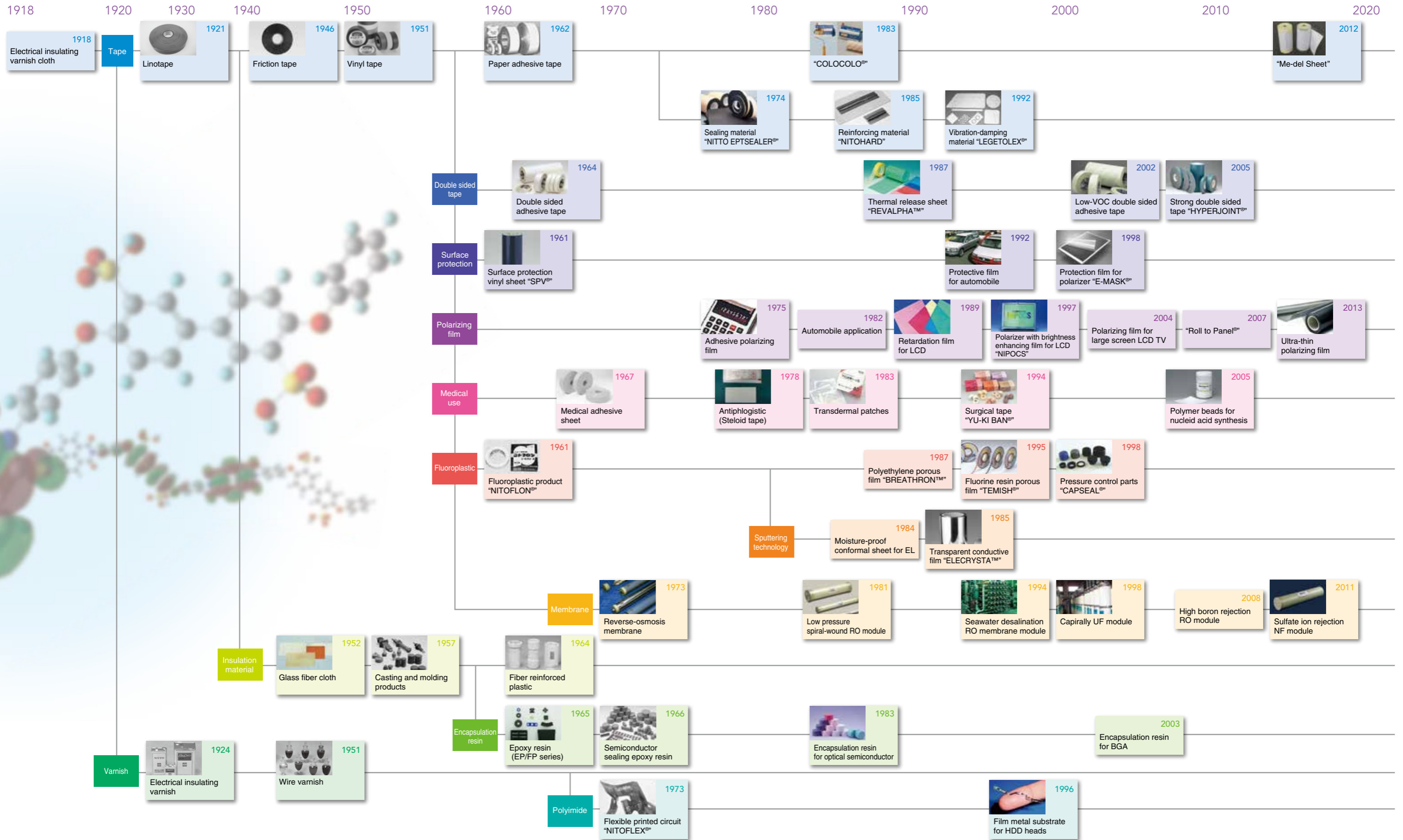


# History of Technological Innovation

Throughout its century-long history, the Nitto Group has given birth to numerous products through combinations of its proprietary technologies and expanded the scope of its business to various fields by courageously adapting to the changes of the times and applying the technologies and products that it has developed.



# Innovations to Shape the Next Generation

As progress in IoT, AI, and other emerging technologies accelerates, the society and market environment that we find ourselves in are undergoing major transformations. Identifying the opportunities presented by such changes, we at the Nitto Group strive to create new value through the convergence of technology, business, people, and business domains, which allows us to quickly perceive social needs and offer solutions to various issues.

Proposals for the Future!

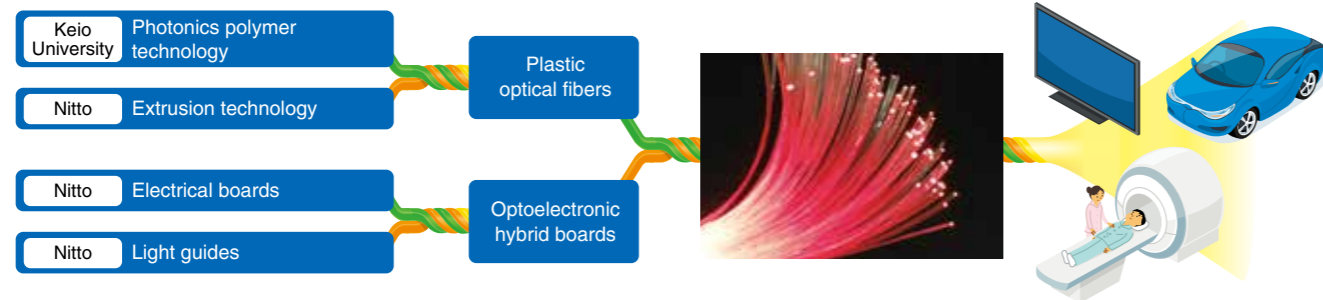
## Entering the Plastic Optical Cable Business

The spread of IoT and the commercialization of 8K broadcasting have made it imperative to realize next-generation, high-speed, large-capacity communications.

In October 2017, we established an Optical Cable Joint Research Center together with Keio University. By fusing the photonics polymer technology accumulated over many years by Keio University with the extrusion technology of the Nitto Group, we are now jointly developing new plastic optical fibers that are

flexible, light, heat-resistant, and low-noise.

Also, by combining optical fibers with optoelectronic hybrid boards, which were born from the fusion of electrical boards and light guides, we are able to produce thinner, finer, and more compact optical cables. Our goal is to begin mass-producing this innovative product at an early date for a diverse range of applications, including 8K TVs, data centers, medical equipment, and autonomous cars.



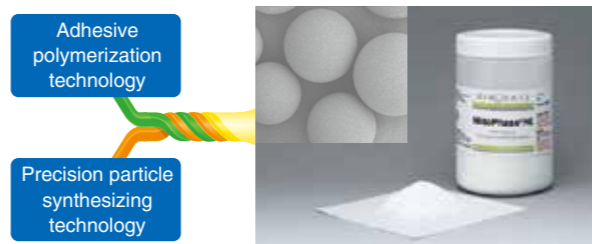
Fine

## Oligonucleotide Business

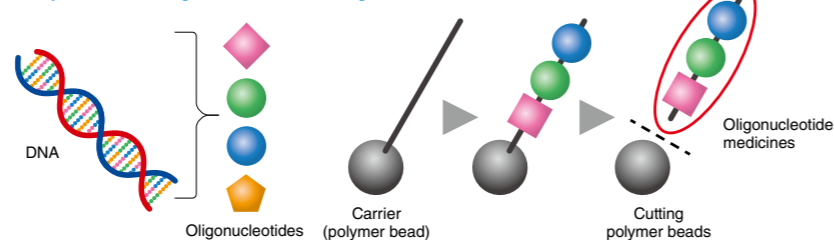
Genes, the blueprints of life, are made up of oligonucleotides such as DNA and RNA. Oligonucleotide medicines are made by connecting several dozen DNA and RNA strands and are being hailed as next-generation pharmaceuticals, since they are expected to be effective against difficult-to-cure cancers and other intractable diseases.

NittoPhase®, a carrier for oligonucleotide synthesis, is indispensable for the production of such medicines because its porous polymer beads facilitate high-yield synthesis of highly pure oligonucleotides. This product was originally derived from particles for diagnostic agents, which were developed by combining the Nitto Group's proprietary technologies in adhesive and polymer design.

This oligonucleotide synthesis carrier opened the door to a new market, and now Nitto offers one-stop support for creation of oligonucleotide medicines, covering everything from contract manufacturing of oligonucleotides for use in preclinical studies, clinical studies, and commercial production to analysis and aseptic fill & finish services.



### Synthesis of oligonucleotides using NittoPhase®



In this chapter, we introduce our new products and services, and those we aim to commercialize, as well as our existing products and services.

**Green** **Clean** **Fine**

Products and services in new domains that Nitto is putting emphasis on

Proposals for the Future!

Products and services which we aim to commercialize.

Fine

## Wireless Charging of Hearing Instruments

Nitto teamed up with RION Co., Ltd. to jointly develop a wireless charging system for hearing instruments.

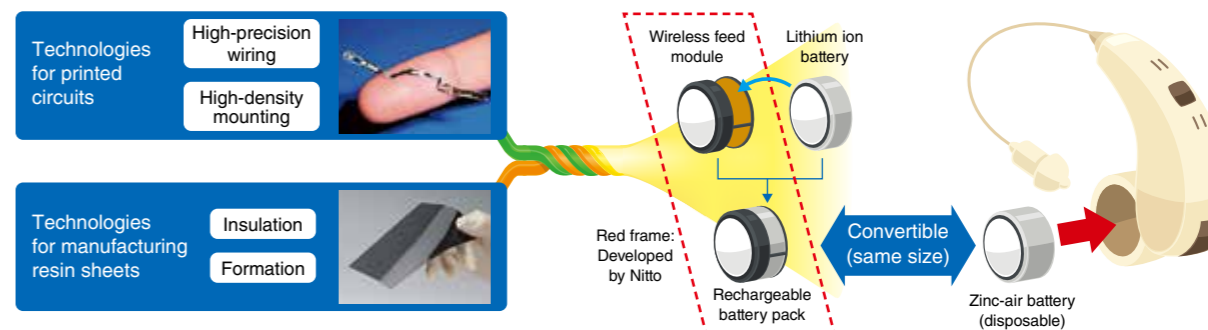
Typically, hearing aids use zinc-air batteries\* or rechargeable batteries, but the former must be replaced regularly, while the latter need to be charged daily. Both of these battery types can be used with this brand new charging system. Even if the hearing instrument's rechargeable battery loses its charge, it can be replaced with a zinc-air battery, thus making it possible to immediately start using it again. By making use of the Nitto Group's proprietary technologies for printed circuits, including high-precision wiring and high-density mounting, as well as technology for manufacturing resin sheets, we have been able to downsize rechargeable batteries without compromising their performance.

Further adding to user convenience is the newly developed wireless charging system, which can be used by simply placing the hearing instrument on the adapter. This product is scheduled for launch in the summer of 2018.



The hearing instrument can be set in any direction when charging.

\* Zinc-air batteries: Batteries that generate electricity by using oxygen in the air. Such batteries last longer than dry batteries.



## Repositionable Tape

Repositionable tape is a double-coated tape ideal for wallpaper. Special resin applied in a stripe pattern to the adhesive face allows the tape to be adjusted by sliding. The tape can be pressed down once it is in the appropriate position. A special resin penetrates the adhesive layer for tight adhesion to substrates, and the smoothness of the resin, processing

technology for striped-convex application, and adhesive strength make it possible for the tape to glide on smoothly and adhere securely.

To secure convex lines on the adhesive face, a high-cushioning foam is used as a release liner.



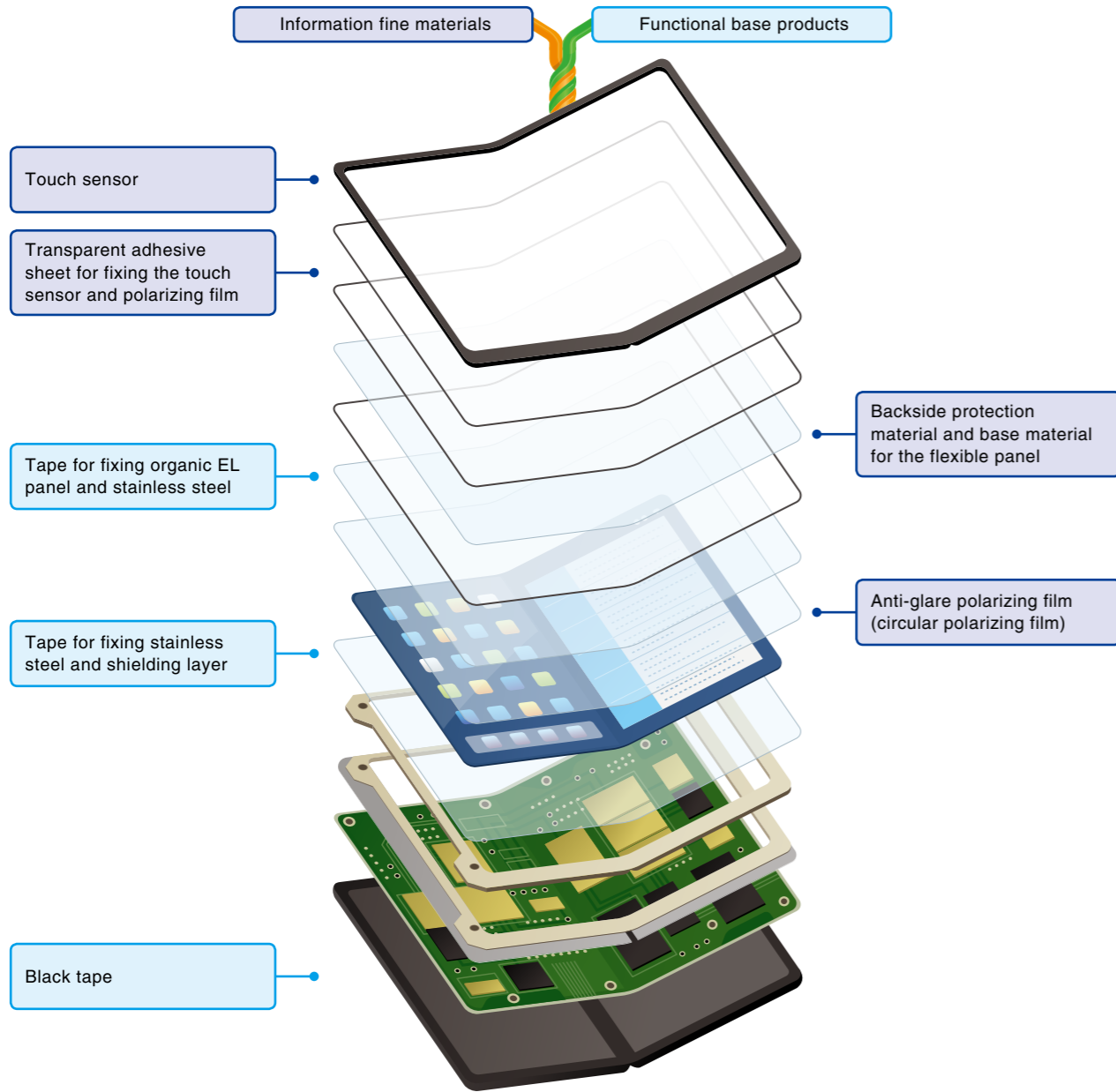


**Nitto's Products Used in Organic EL Displays**

Displays using naturally light-emitting organic electroluminescent (EL) materials do not require backlighting, and thus can be made extremely thin. In addition to TVs and smartphones, which already incorporate such displays, these materials are expected to be applied to flexible (bendable) displays, electronic paper,

and lighting equipment.

Like liquid crystal displays (LCDs), a variety of the Nitto Group's products are used in organic EL displays, including not only information fine materials, but also functional base products for fixing and protecting materials within the displays.



**Technical Partnership with Hangzhou Jinjiang Group, etc. for Large-Scale Polarizing Films**

Nitto entered into a technical partnership contract with Hangzhou Jinjiang Group Company Ltd. and its affiliated companies to help them to meet the increasing demand in China for large-scale

polarizing films used in LCD TVs. Through this partnership, Nitto will assist the Hangzhou Jinjiang Group in introducing one of the world's largest front-end polarizing film facilities to China.

Proposals for the Future!

**Fine**

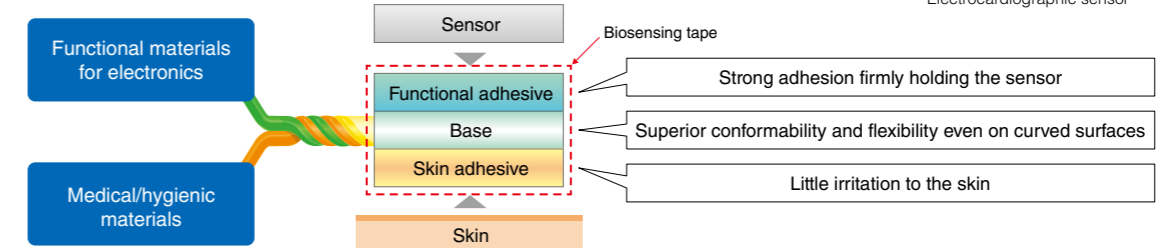
**Biosensing Tape**

Directly applied to the skin for electrocardiograms and other vital data measurements, biosensing tape material must adhere securely so that it does not slip off, yet must also be gentle on the skin.

The Nitto Group possesses technologies required for both functional materials, which are used chiefly in electronics applications, and medical/hygienic materials. To meet these requirements, we came up with the idea of combining highly adhesive functional materials for electronics with low-irritant medical/hygienic materials. We also chose a flexible base (core) from among many materials to develop tape exclusively for biosensing, and sample work started soon after that. While verifying any issues that come up, we will continue improving the product until we can fully meet our customers' expectations.



Electrocardiographic sensor



**Green**

**Visible Light-Blocking Material for HUDs**

As evidenced by rapid progress in autonomous cars, automobiles are becoming increasingly electronic, and head-up displays (HUDs) that let drivers see information on potential danger are expected to grow in demand. While HUD screens grow larger to display ever-increasing volumes of information on things like oncoming vehicles and pedestrians, solutions must be found to counteract sunlight concentration, which can cause trouble with HUD units.

Having quickly anticipated such latent issues through its customer-oriented marketing activities, the Nitto Group leveraged the optical material design technology cultivated for its information fine materials in order to develop a visible light-blocking material. Offering superb heat resistance, this groundbreaking product cuts sunlight to lengthen the HUD unit's service life. Since it can be attached directly onto the covering material, HUD units require no major design changes.

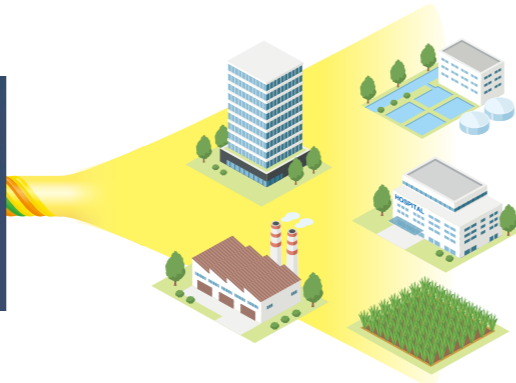
Going forward, we plan to release a new product that combines a visible light-blocking material with a covering material in order to help customers to simplify their production processes.

**HUD projected image**



**Green Membrane Products**

- Polymer design/synthesis technology
- Coating technology
- Thin film forming technology



The Nitto Group's membrane products were created through the combination of multiple technologies, including polymer design/synthesis and thin film formation. These various types of membranes are used for a wide range of applications, such as seawater desalination, wastewater treatment, and ultra-pure water production, with each membrane type having its own unique characteristics specialized for specific uses.

ESPA®2-LD MAX, for instance, is a reverse osmosis (RO) membrane that achieves both energy conservation and high permeability by maximizing the membrane area per element. This revolutionary membrane was adopted for use in the Keppel Marina East Desalination Plant (KMEDP) in Singapore, which will be the city-state's first large-scale water treatment plant capable of treating both seawater and fresh water. This plant has also been attracting attention thanks to its innovative design, as a lush green park will be built directly above the plant and the plant

itself will feature a public viewing gallery within its walls.

Due to its small land area and the resulting difficulty in collecting sufficient rainwater to meet its needs, Singapore is attempting to improve its water self-sufficiency by increasing the utilization of recycled wastewater (NEWater\*) and desalinated seawater. Since the year 2000, the Nitto Group has been engaged in the Singapore Public Utilities Board's NEWater Projects. Through its water treatment membrane technologies, the Nitto Group has contributed greatly to furthering Singapore's water self-sufficiency. Furthermore, one of the main challenges faced by the KMEDP has been power efficiency, and ESPA®2-LD MAX is expected to be a key factor in addressing this issue.

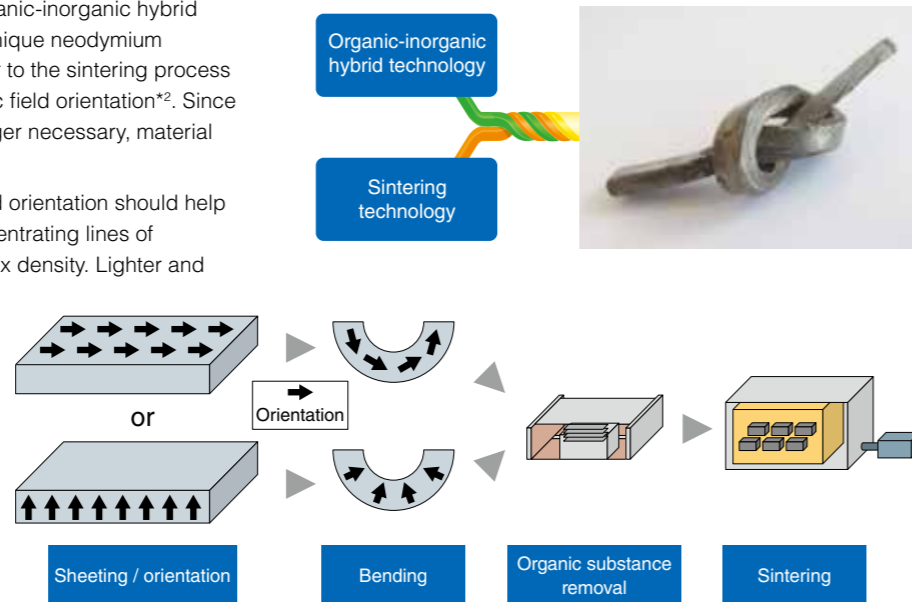
\* Recycled wastewater that is treated through cutting-edge membrane and ultraviolet disinfection technologies and satisfies the standards for potable water.

**Clean Neodymium Magnets**

In 2015, the Nitto Group applied its organic-inorganic hybrid technology\*1 to successfully develop unique neodymium magnets that can be freely formed prior to the sintering process and are capable of controlling magnetic field orientation\*2. Since post-sintering shaving tasks are no longer necessary, material losses are reduced.

Also, the ability to control magnetic field orientation should help to improve motor performance by concentrating lines of magnetic force to increase magnetic flux density. Lighter and more compact motors should also help to increase fuel efficiency and lower power consumption to conserve energy.

\*1 Technology for combining organic and inorganic constituents on the nano and molecular levels  
\*2 Technology for manipulating directions of unidirectionally aligned magnet crystals



Proposals for the Future!

**Mono (Products) and Koto (Value) for the Future**

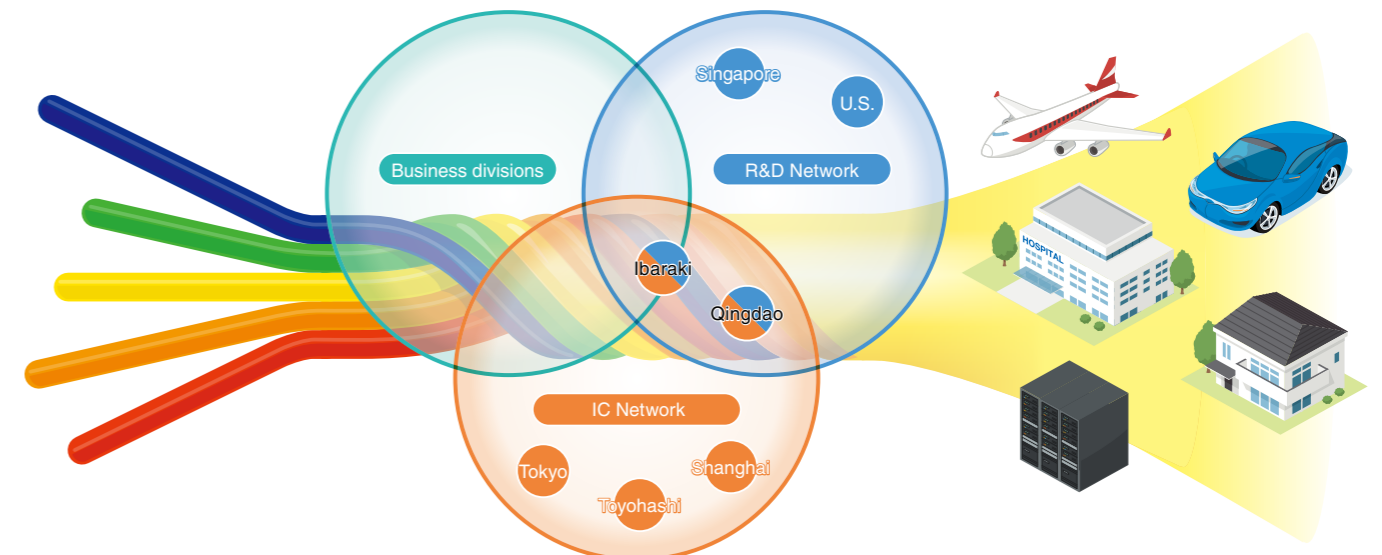
**Convergence and Multi-Exit Approach**

So far, a linear process has been followed from research and development and marketing to production under a set framework, such as a business division.

However, this "baton-passing" approach no longer functions, and we have entered an age where it is required not only to manufacture "products," but also to think outside of the box and create "value," in order to survive. To stay current with constantly accelerating social changes, the Nitto Group intends to transcend its organizational framework to bring about brand new innovations by converging technologies and knowledge from both within

and beyond the Group. We will also take a multi-exit approach to find product applications not just in a limited number of industries, but in a variety of other fields as well.

The Nitto Group continues to create new value at its five innovation centers (ICs) and R&D centers in four countries. Opened in March 2016 within the Ibaraki Office, Japan, inovas has welcomed a total of more than 2,000 visitors over the past two years, receiving many positive hopes and hints for future innovations. We will tap into such input to sow a great number of research seeds and carefully cultivate them to achieve a bountiful harvest of results.



**Amalgamation of Business and Intellectual Property**

The Nitto Group has pursued intellectual property strategies through an amalgamation of its businesses and intellectual property in order to bring about business results. By adopting non-manufacturing business models, such as technological alliances and new approaches to intellectual property protection that also protect business models, we implement intellectual property-related activities that best match the circumstances of each market.

In recognition of our dedication to proper protection of ideas leading to inventions and maximization of their value through effective commercialization, the Nitto Group was selected by Clarivate Analytics as one of its "2017 Top 100 Global Innovators" for the seventh consecutive year. Among the four evaluation criteria of "number of patents," "success rate," "global performance," and "influence of the patent," we were particularly highly evaluated in terms of "influence of the patent," which shows how widely our patents are cited by other companies and organizations.

■ Patent Publications of the Nitto Group (In Japan and major countries)

