

Creating a Fusion of Core Technologies to Achieve Continual Growth

Past and future: an explanation of the Nippon Kayaku vision for continual growth

Since its founding in 1916, Nippon Kayaku has continued to expand its core technology fields and create a fusion of our core technologies, aiming to be the global No. 1 in niche markets. By continuing to use this “DNA for change,” we will achieve constant growth in the future. Here, we would like to take a look back at the history of the Nippon Kayaku core technologies, and explain our scenario for continual future growth by creating new products and new business areas through a fusion of technologies.

Nippon Kayaku History and Core Technologies

Since our founding in 1916, we have established a range of core technologies in the fine chemicals field.

The fine chemicals technologies that Nippon Kayaku has developed in the explosives, dyes, pharmaceuticals, resins, and other fields have been established as our company's core technologies. The majority of these core technologies were introduced for the purpose of revitalizing Japanese industry and contributing to the creation of an affluent society.

Explosives technologies

Nihon Kayaku Seizou Co., Ltd., the predecessor of the modern Nippon Kayaku, was founded in 1916, becoming the first private company in Japan to manufacture industrial explosives. Beginning with the production of black powder, we also became involved in production of fuses and detonating caps, gradually developing

into a comprehensive explosives manufacturer. During World War II, while other explosives companies converted to the production of military explosives, we were concerned that decreasing our production of industrial explosives would result in the deterioration of our base industry, and we continued to concentrate on the production of industrial explosives.

Dye technologies

Teikoku Senryo Seizou Co., Ltd. was founded in 1916, and in the same year succeeded in mass producing sulfur black BX. However the company standing deteriorated as a result of fierce competition over market share, and the production equipment and other facilities were neglected and remained unimproved. In 1928, Nihon Kayaku Seizou acquired Teikoku Senryo Seizou and began modernizing its production system. In 1929, this company succeeded in domestic production of Carbanol Blue, a competitor to the German product Hydron Blue which was very popular at the time. Carbanol Blue became a tremendous hit, even surpassing its imported rival.

Pharmaceutical technologies

In 1931, Nihon Kayaku Seizou founded Yamakawa Seiyaku Co., Ltd. for the domestic manufacture of aspirin. At the time, Japan depended on German imports for synthetic pharmaceuticals, and spent a vast sum on them each year. Yamakawa Seiyaku succeeded in manufacturing aspirin in 1932. This product was recognized for its high quality, and was even exported to England and Germany. This company continued to make great contributions to the medical field, including with the manufacture of penicillin in 1948 and the marketing of the anti-cancer drug BLEOMYCIN in 1969.

Agrochemical technologies

Production of the soil fumigant CHLOROPICRIN began at the Kokura Plant in 1934. In 1956, Nippon Kayaku carried out a collaboration with Geigy AG, Switzerland and began the production and sales of the insecticide DIAZINON the following year. We later changed the formula and marketed DIAZINON as an agricultural pesticide. The DIAZINON 3% granules we later marketed grew to become our company's primary product, and in the year 1970 we shipped 15,000 tons of DIAZINON-related products, which expanded to become the primary pesticide used in the wet-rice agriculture field.

Catalyst technologies

In May 1964, Nippon Kayaku made improvements to technology from the U.S. company Sohio and developed a catalyst used in the synthesis of acrylic acid. Nippon Kayaku and Sohio concluded an agreement in 1979 to combine their acrylic acid technologies and conduct business under a cooperative license agreement to produce acrylic acid that was in the world's top class. The overseas business to which the license was jointly granted then gradually grew to its present size.

Resin technologies

In 1959, Nippon Kayaku joined the Polymer Material R&D Association in order to begin production of acetylene and ethylene. In 1965 we established the Takasaki Research Center and created a system for full-scale entry into the petrochemicals field. The epoxy resin project was launched in that same year, leading to the development of the semiconductor encapsulation epoxy resin EOCN, the reactive diluents GOT and GAN, and the reactive flame retardant BROCN. In 1970, we founded Nissho Kayaku Co., Ltd. as a joint venture with Showa Denko Co., Ltd., and began production of acrolein, acrylic acid, and acrylic acid ester. In 1971, we established a new resin division and began sales of epoxy resin curing agents and flame retardant epoxy resins.

Creating New Products and New Business Areas Through a Fusion of Core Technologies

We have created new products and new business areas through a fusion of core technologies from the fine chemicals field.

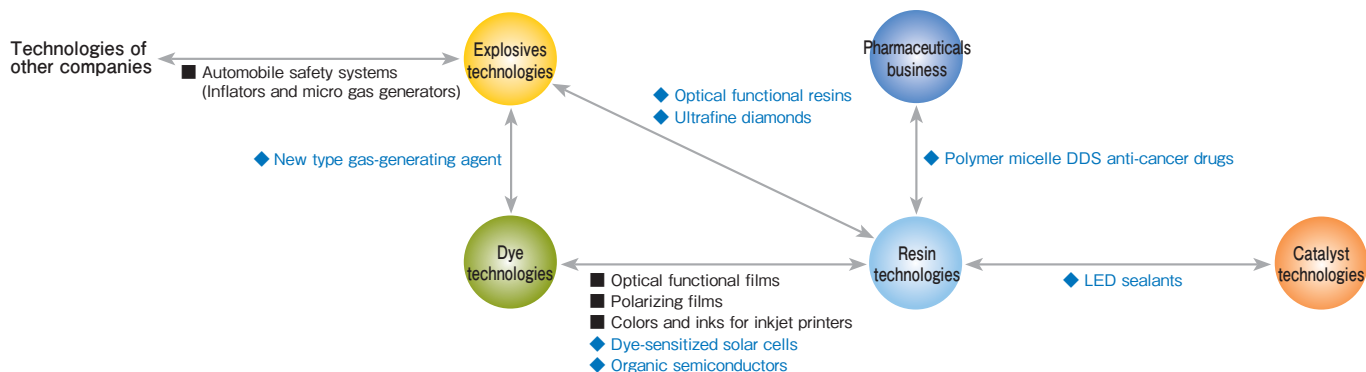
In 1943, Nihon Kayaku Seizou Co., Ltd. merged with Teikoku Senryo Seizou Co., Ltd. and Yamakawa Seiyaku Co., Ltd., and in 1945 the company name was changed to the current name of Nippon Kayaku Co., Ltd. This merger was conducted as an effort to make effective use of business resources in order to survive the turbulence of the war and post-war periods. It was at that time that we began to create a fusion of the core technologies from each of these companies.

For example, we adapted ignition technology from the explosives field to create our automobile safety component business, producing inflators and micro gas generators. We fused low-molecular-weight-compound synthesis technology from the pharmaceutical field with polymer technology from the resin field to create our polymer micelle drug delivery system (DDS) anti-cancer drugs. Clinical trials of these products are now under way. Furthermore, the technologies for the synthesis and compounding of dyes have been applied to create colors for inkjet printers and color filters for digital cameras. By fusing these technologies with applied resin technologies, the businesses of polarizing films and optical functional films were started.

Nippon Kayaku Core Technologies and Technology Fusion

■ Commercialized fusion of technologies

◆ A fusion of technologies leading to the creation of commercial products



Scenario for Growth Based on Collaboration and Fusion

Aiming to be the global No. 1 in niche markets by strengthening our core businesses through collaboration and fusion.

At the Nippon Kayaku Group, we are strengthening our efforts at collaboration, including M&A, and promoting a fusion of our developed technologies, in order to carry out the changes necessary to meet the challenging demands of the times. In recent years we have efficiently expanded our business by establishing three core business areas: information/communications (functional chemicals business), health care (pharmaceuticals business), and safety systems (safety systems business). We are also directing our efforts toward the development of new products in the environment and energy conservation field which meet the increasingly urgent environmental needs of our times — products such as environmentally friendly epoxy resins, LED-related materials, and dye-sensitized solar cells.

In order to further strengthen these core businesses, it is important that we rapidly carry out the process of launching new business. It is precisely for this reason that we have introduced the project system. This system allows us to create an organization where we can cross compartmentalizing organizational barriers and bring together team members from various divisions to be in charge of operations, and where these team members can share information and quickly carry out their important work without hindrance.

New Products Created from Collaboration and Fusion

Environment and energy conservation products

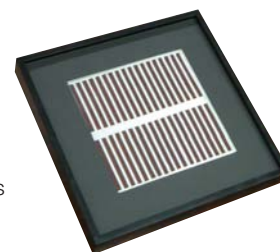
● Environmentally friendly epoxy resins

The NC-3000 Series of environmentally friendly epoxy resins can be used to create flame-retardant cured products without adding any phosphorous or halogen flame retardants. These resins can also be used in combination with lead-free solder that has a melting point more than 20°C higher than conventional ones. These resins are used in a broad range of applications, including semiconductor encapsulation and PCBs. As high-end products, these resins have established a position as the *de facto* standard in the market.



● Dye-sensitized solar cells

Dye-sensitized solar cells are solar cells that utilize titanium oxide nanoparticles. Because the size of these titanium oxide nanoparticles is on the nanometer scale, the solar cells have a larger surface area and are able to more efficiently absorb sunlight. This product was born from a fusion of our company's dye technologies and resin technologies.



● Organic semiconductors

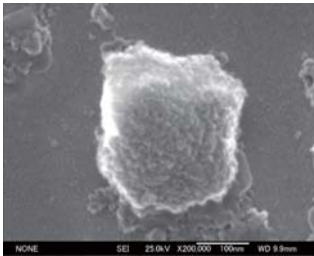
Compared to silicon-based semiconductors, semiconductors that instead utilize organic materials feature superior machining performance and a shorter manufacturing process, which allows energy savings during manufacturing. Nippon Kayaku is making extensive use of its synthesis technologies, high purity technologies, and ink development technologies to create next-generation materials.

● New type gas-generating agent

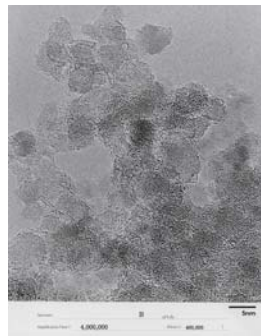
Reducing the weight and size of automobile components is essential in order to improve automobile fuel economy. Nippon Kayaku is applying one of its core technologies — explosives technology — to develop a new type gas-generating agent for smaller and lighter-weight inflators and micro gas generators that will contribute to energy-savings in automobiles.

● **Ultrafine diamonds**

Nippon Kayaku has succeeded in establishing integrated manufacturing technology for ultrafine diamonds using the explosive synthesis method. We are proceeding with the development of new applications for these diamonds as highly functional materials, such as its use in precision grinding and in electronic information materials that utilize the high refractive index, thermal conductivity, and other superior characteristics of diamonds.



Electron microscope photograph of polycrystalline diamond



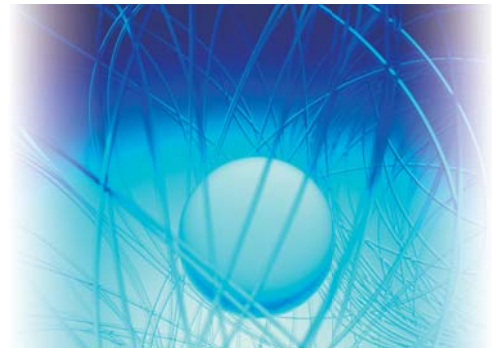
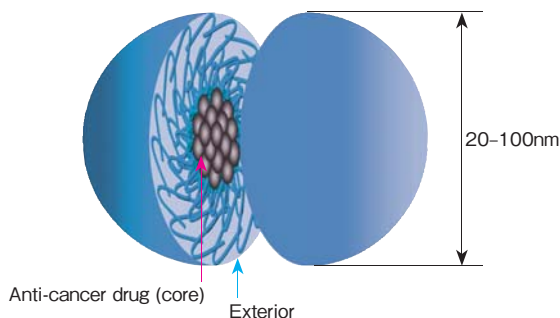
Electron microscope photograph of monocrystalline diamond

Pharmaceutical products

● **Polymer micelle anti-cancer drugs**

NK105, which is now undergoing clinical trials, is a drug delivery system of a size that easily collects on cancer cells, and which utilizes a polymer to contain PACLITAXEL, a drug used in the treatment of breast cancer and stomach cancer. The produced polymer micelles are 20–100 nanometers in diameter. While they cannot pass through the walls of healthy peripheral blood vessels, the walls of the blood vessels in tumor tissue contain gaps through which the micelles can pass and effectively deliver the drug to cancer cells. We are also proceeding with the development of the similar drug NK012.

Polymer micelle anti-cancer drug



Concentration of Business Resources in Growth Fields

We are concentrating business resources in the three fields of the environment, health care, and safety in order to contribute to the creation of an affluent society and achieve continual growth.

● **Environment, Energy Saving, and Information/Communications: Functional Chemicals Business**

Nippon Kayaku is producing environmentally friendly products as well as IT-related products and materials. We are producing the high-performance plastics and optical functional films that are used in cellular phones and digital information home electronics, and are also focusing on products such as environmentally friendly epoxy resins and dye-sensitized solar cells.

● **Health Care: Pharmaceuticals Business**

Nippon Kayaku is specializing its business in cancer-related fields. Our technologies for developing products such as polymer micelle drug delivery system (DDS) anti-cancer drugs, and our capability to provide information to medical institutions give us a strength that no other company can match.

● **Safety: Safety Systems Business**

Nippon Kayaku is manufacturing components for airbags and other automobile safety systems. We are using a global production system for products such as automobile airbag components and seatbelt pretensioner components in order to flexibly meet the needs of the globalizing automobile industry.