

Research and Development

Our R&D strategy in the new medium-term business plan The TOP 2021 is to continue taking measures to make existing businesses *Koseiha* Businesses (individualized businesses) and to give priority to establishing pipelines to create new businesses.

To promote the individualization of existing businesses, we have reorganized the Institute for Integrated Product Development, which had been established in 2016, and will accelerate and expand the “deepening” and “fusion” of technologies, and share them in the whole company. Besides, by making the Institute for Integrated Product Development function as an organization to pool technical engineers for the whole company, we will promote the creation of innovative technologies and human resource development through a fusion of diverse engineers and technologies. In this way, we will strengthen our system to make the best use of human resources in terms of quality and quantity. We will also promote open innovation and M&As to introduce necessary technologies from outside entities.

To accelerate the creation of new businesses through our value-added pipelines, we will strengthen our marketing function to grasp market and technology trends and identify targets for R&D, and invest our R&D resources intensively in ten technical fields, which includes multi-material / adhesion of different materials and the process to produce next-generation semiconductors. The ten notable technical fields correspond to seven business domains, transportation, energy, lifestyle, electronics, construction/infrastructure, industrial equipment, and life science & healthcare.

To execute these measures, we will increase R&D personnel by about 10% and R&D investment by about 30% during the period of The TOP 2021.

In addition, we have established the Advanced Technology Laboratory whose mission is to search for and plan next-generation R&D themes using a liberal way of thinking, free from trends in existing business fields and industries.

Through these measures, we will create a culture of technology-based corporate development represented by the key words “deepening (strengthening and handling down),” “fusion,” and “introduction.”

To realize the concept of The TOP 2021, we will establish a complex called Stage for Fusion which will accelerate deepening, fusion and the introduction of technologies inside and outside the company. Stage for Fusion will be built next to the Yokohama Plant, and will come into service in 2022.

By strengthening our R&D activities, we will create products and services that “touch the heart,” and will act to offer solutions that make society better.

Under the medium-term business plan The TOP 2021, we plan to invest ¥71.0 billion in R&D in the three years from 2019 through 2021. We will continue to strengthen existing businesses and give priority to setting up pipelines to create new businesses.

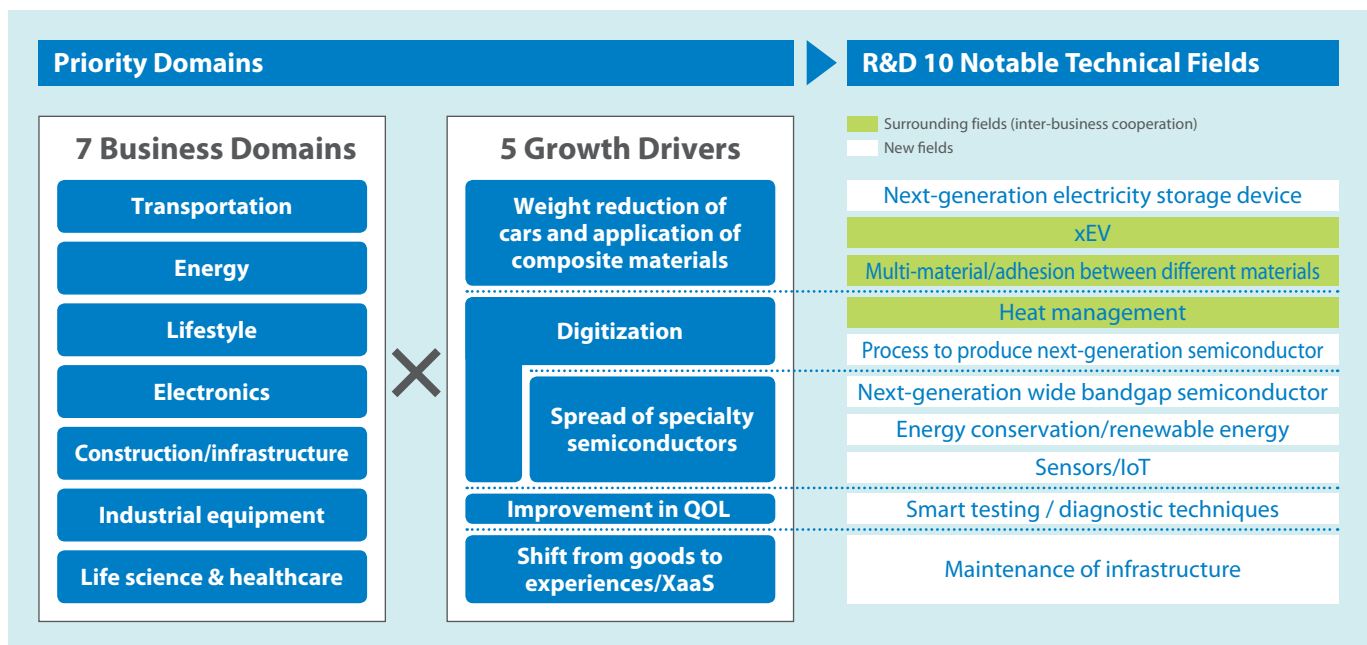
1. Establishment of pipelines to create new businesses

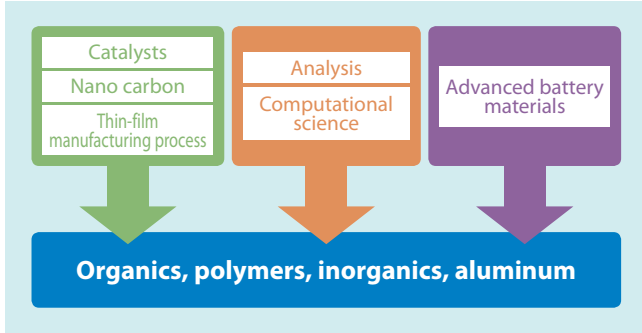
To set up pipelines to create new businesses, we will invest our R&D resources intensively in ten notable technical fields corresponding to seven business domains.

To support this R&D investment program, we will make the best use of 1) technical research activities including technical marketing, which is to investigate trends in advanced technologies and help researchers to set new R&D themes, 2) inter-business cooperation in which several divisions cooperate to collect knowledge and suggest solutions to produce target products, and 3) an in-house campaign to collect ideas from employees. In addition, we will positively make effective use of open innovation and M&As, aiming to search for R&D themes by introducing technologies from outside entities.

2. Expanding the role of the Institute for Integrated Product Development

The institute for Integrated Product Development (IIPD) has been developing new products through the fusion of technologies in the fields of organics, polymers, aluminum, and inorganics, and has successfully developed many products. On the other hand, we have





made so much progress in R&D themes pursued by the Institute for Advanced and Core Technology (IACT), and now we can expect to obtain results. Therefore, we have decided to have IIPD take over those R&D themes pursued by IACT, and continue to strengthen existing businesses. As a result of this change, IIPD can now additionally fuse technologies for batteries, carbon and thin film, and will aim to strengthen their R&D capability further. Moreover, we have integrated operation of the Analysis & Physical Properties Center and Computational Science and Technology Information Center into that of IIPD, aiming to accelerate our R&D processes and obtain results more swiftly.

The Advanced Technology Laboratory, which was newly organized in January 2019 under a mission to research next-generation R&D themes and state-of-the-art technologies, will research R&D themes from the perspective of SDGs and ELSI (ethics, legal and social issues).

3. New complex Stage for Fusion

To realize the concept of The TOP 2021, we establish a complex Stage for Fusion, which will accelerate deepening, fusion, and introduction of technologies inside and outside the Company. At Stage for Fusion, we will 1) search for products and technologies that will become important for society in the future and pursue ways to put them into practical use, 2) improve technologies related to electronics materials and contribute to the realization of Society 5.0*, and 3) create methods to accelerate development of materials by making effective use of AI (artificial intelligence). In this way, we will conduct R&D programs to develop integrated products with the assistance of analytical technologies and computational science, thereby creating new value.

*Society 5.0 was proposed by the Japanese Government in the 5th Science and Technology Basic Plan as a future society that Japan should aspire to. It follows the hunting society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0).



New complex Stage for Fusion

R&D Expenditures in 2018

(Millions of yen)

Petrochemicals	Chemicals	Electronics	Inorganics	Aluminum	Others	Total
1,414	2,703	5,157	586	1,860	8,015	19,735

TOPICS Expanded capacity to produce high-grade SiC epitaxial wafers

SDK expanded the capacity to produce high-quality-grade silicon carbide (SiC) epitaxial wafers for power semiconductors, which had been marketed under the trade name of High-Grade Epi (HGE), for the third time in the last three years. SDK has been gradually expanding the capacity to produce wafers*, which was 3,000 per month in the first half of 2017. After the latest expansion work completed in February 2019, SDK's HGE production capacity became 9,000 wafers per month, or three times as much as the first half of 2017. SDK's SiC epitaxial wafers business has been acclaimed by power semiconductor manufacturers, our customers, for the lowest incidence of crystal defects and the highest homogeneity of wafers in the world. SDK expanded the HGE production facilities to respond to the growing need of our customers for HGE resulting from the rapid growth of the market for SiC-based power semiconductors. When compared with current mainstream silicon-based semiconductors, SiC-based power semiconductors can

operate high temperatures, high voltage, and high currents, while conserving energy. These features enable device manufacturers to produce smaller, lighter, and more energy-efficient next-generation power control modules. In addition to use in power modules for dispersion power sources to utilize new energy sources, power modules for servers in data centers, and inverter modules for railcars, SiC-based power semiconductors are now replacing conventional silicon-based semiconductors for use in on-board battery chargers and rapid charging stations for EVs, in parallel with the rapid expansion of the EV market. SDK will continue improving the quality of SiC epitaxial wafers products and supplying them to the rapidly growing SiC power semiconductor market in timely and stable manner, while securing a top-level market share.

* This number is based on a conversion into SiC epitaxial wafers for power devices withstanding a voltage of 1,200 V.