

RESEARCH & BUSINESS DEVELOPMENT

Research & Business Development (R&BD) is an integral part of KKPC's strategy. We leverage our unique, specialized R&BD strategy, and by combining with unwavering commitment to innovation, we focus on maximizing synergy in our core businesses and developing next generation growth engines.

MAJOR INNOVATIONS

- Synthetic Rubbers**
 - Developed F-LiBR for tires
 - Commercialized NB latex with outstanding chemical resistance
- Synthetic Resins**
 - Developed eco-friendly SAN resin
- Specialty Chemicals**
 - Developed multi-functional epoxy paint diluent
- Electronic Materials**
 - Developed a new ArF immersion BARC product

R&BD ORGANIZATION

In 2005, KKPC moved away from typical R&D and adopted a new concept called Research & Business Development (R&BD). R&BD transcends traditional simple R&D activities and undertakes technological development which aims at creating value by connecting the project and commercialization right from the initial selection of the research project, and then planning for marketing, commercialization, etc. R&BD activities drive our sustainable growth, and revolve around two major pillars – the Kumho Petrochemical R&BD Center and the Kumho Electronic Materials Laboratory. The Kumho Petrochemical R&BD Center in particular became the first in chemicals research to build a research project management system, and it conducts company-wide feasibility analysis beginning with the selection of research projects. All projects are divided into basic research, development and commercialization phases, and then managed in a systematic manner, thus maximizing the efficiency of our R&BD activities.

KUMHO PETROCHEMICAL R&BD CENTER

The Kumho Petrochemical R&BD Center was first established at our Yeosu plant in 1985, and it was subsequently expanded and relocated to Daedeok Innopolis in 1994. This was then followed by the integration of our Icheon R&D center and the Ulsan Latex R&D center in 2003 to launch the present Kumho Petrochemical R&BD Center.

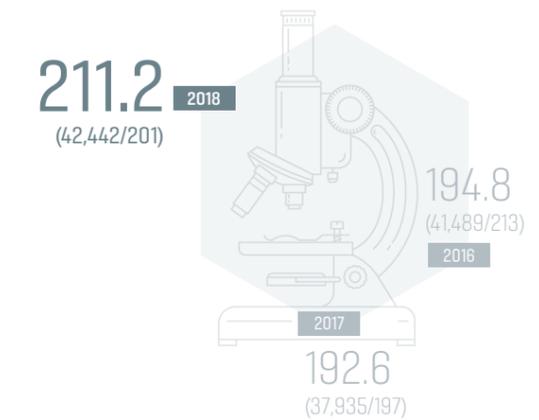
It undertakes advanced research to ensure technological and price competitiveness in our existing products, including synthetic rubbers, synthetic resins and specialty chemicals. It also focuses on developing next generation growth drivers. The Center takes the lead in creating market-leading products through detailed research in four areas – developing new products to meet customer needs, upgrading

quality and developing eco-friendly products for better competitiveness, creating new growth drivers with the aim of developing core business items for the future, and applied research of key technologies in order to maintain a business sustainability. In addition, the Center aims to make technological breakthroughs that enable our recently-launched products to become the best in the world.

In 2018, the Center formed a research organization that will lead the development of distinctive technologies for product groups connected to existing businesses, while also improving its organization to be centered around research projects. This system allows us to respond rapidly to changes in the business environment and technologies through continuous research and development in current and future businesses. The Center will continue to identify and develop further world-class products, as well as the next-generation technologies that will enable us to create new synthetic materials.



R&BD INVESTMENT PER PERSON (Unit: KRW million)



* R&BD investment is the sum of budgets for expenditures and investment

KUMHO ELECTRONIC MATERIALS LABORATORY

The Kumho Electronic Materials Laboratory was opened in Asan, South Chungcheong Province, in 1998 to conduct R&D activities of semiconductor and display materials. In 2018, it strengthened its capabilities in new business by adding the CNT research team. Its location next to a production plant gives the Laboratory strengths in quality improvements, new product development and commercialization across all of its targeted businesses, which include semiconductor products, such as photoresist (PR), bottom anti-reflective coating (BARC) and photosensitive polyimide (PSPI), transparent resins and functional adhesives for displays, and applied CNT composite products.

The Laboratory has registered more than 200 patents in PR, being recognized as a leading Korean researcher in this area. Based on the technologies, KKPC has been developing advanced products that meet customer requirements and generating significant export growth. The Laboratory is also expanding its market presence by developing products in line with current semiconductor technologies, as well as focusing on next-generation products. In 2018, it concentrated on developing thick PR for 3D NAND flash memory. 3D NAND flash memory is considerably faster than 2D NAND flash memory, has a much greater capacity, consumes less electricity, and offers outstanding stability and durability. Although NAND flash memory manufacturing is structurally simple, volatile pricing has prevented it from gaining much traction in the semiconductor market. However, the recent development of 3D NAND flash memory, which can increase the degree of integration per unit area, has boosted margins as the number of layers has increased.

As a result, there is now considerable emphasis on developing thick PR with an increased number of layers in the Korean and Chinese semiconductor markets. In 2018, we completed the development of KrF and i-line thick PR for 3D NAND flash memory, and began sales in both domestic and overseas markets. We are now working on meeting requirements for additional processes, which is expected to drive an increase in sales.

In the display business, the Laboratory is focused on developing products that can be applied to next-generation displays, with the aim of expanding its product line-up and staying ahead of the competition in future growth drivers. In the CNT business, it aims to increase sales in the mid- to long-term by commercializing high value-added products, including resin applied products, rubber applied products and solution products. In 2019, the Laboratory plans to build on the R&D achievements of 2018 and increase sales across all business areas, from semiconductor and display materials to CNT.

WORLD-CLASS PRODUCTS

- SBR**
Styrene butadiene rubber
- HBR**
High-cis polybutadiene rubber
- NBR**
Acrylonitrile butadiene rubber
- LBR**
Low-cis polybutadiene rubber
- NB Latex**
Acrylonitrile butadiene latex
- KSL-341 foam latex**
- EPDM**
Ethylene propylene diene monomer
- KUMANOX 13 antioxidant**
- KUMANOX 5010L antioxidant**
- PA**
Phenolic additives
- MIBK**
Methyl isobutyl ketone
- BPA**
Bisphenol-A
- Phenol**
- Aceton**
- Polymethylene polyphenylisocyanate**
- Diphenylmethane-4,4, diisocyanate**
- SBS**
Styrene butadiene styrene