

KIMM

KOREA INSTITUTE OF
MACHINERY & MATERIALS

KIMM



ENHANCING FUTURE PROSPECTS THROUGH
MECHANICAL TECHNOLOGY INNOVATION

GENERAL INFORMATION

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MAJOR FUNCTIONS PERSONNEL & BUDGET

MISSION

To contribute to economic growth of the nation by performing research & development(R&D) on key technologies in the area of mechanical engineering. To achieve this, KIMM conducts reliability tests, evaluates machine components materials, and commercializes the developed products or machineries through technology transfer and support.

MAJOR FUNCTIONS



PERSONNEL

531

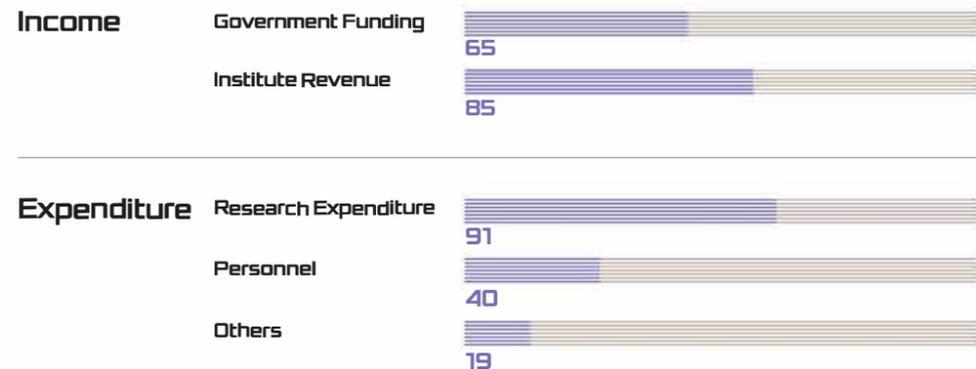
Unit
Persons, as of 2023



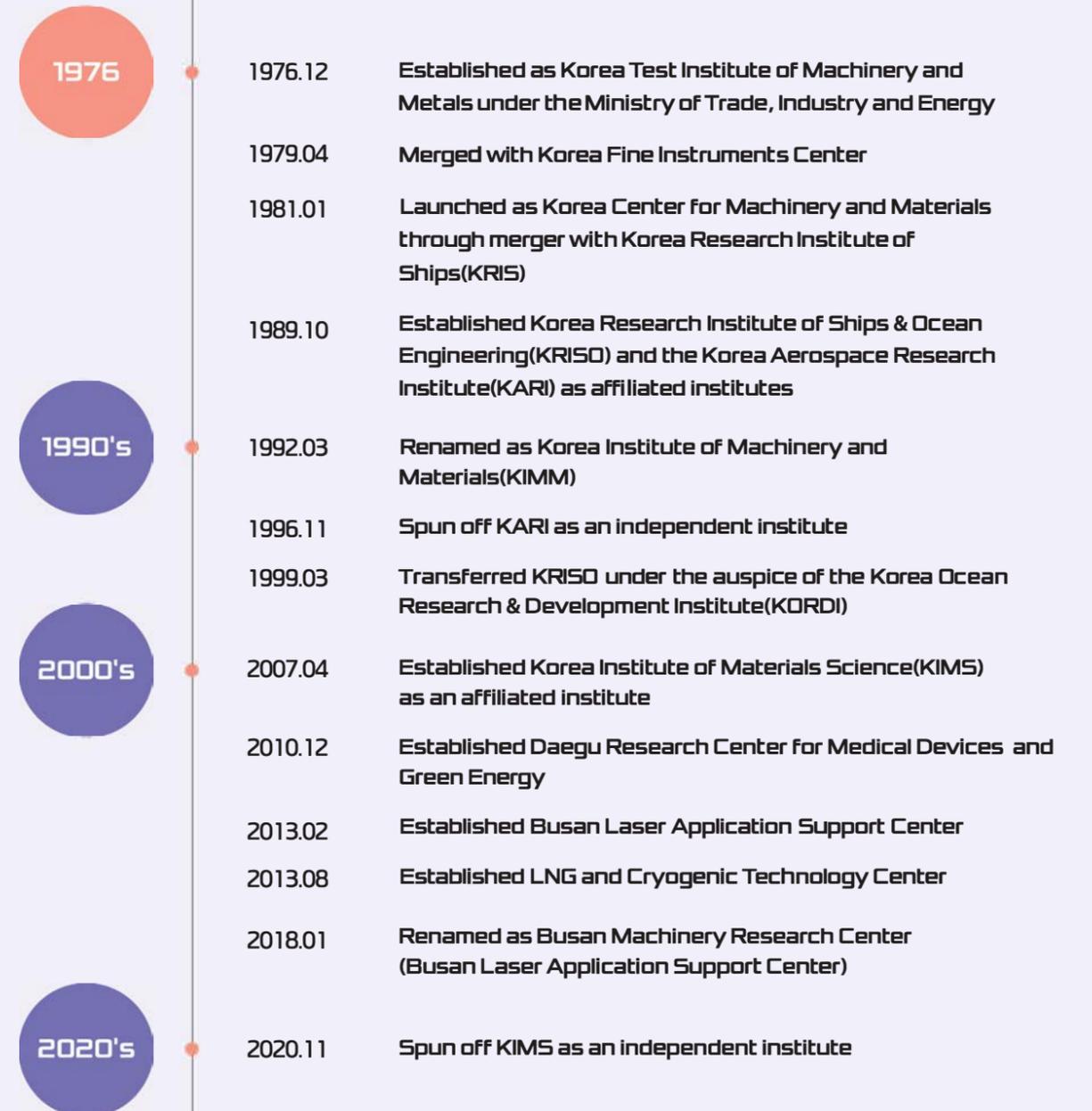
BUDGET

150

Unit
Million USD, as of 2023



HISTORY



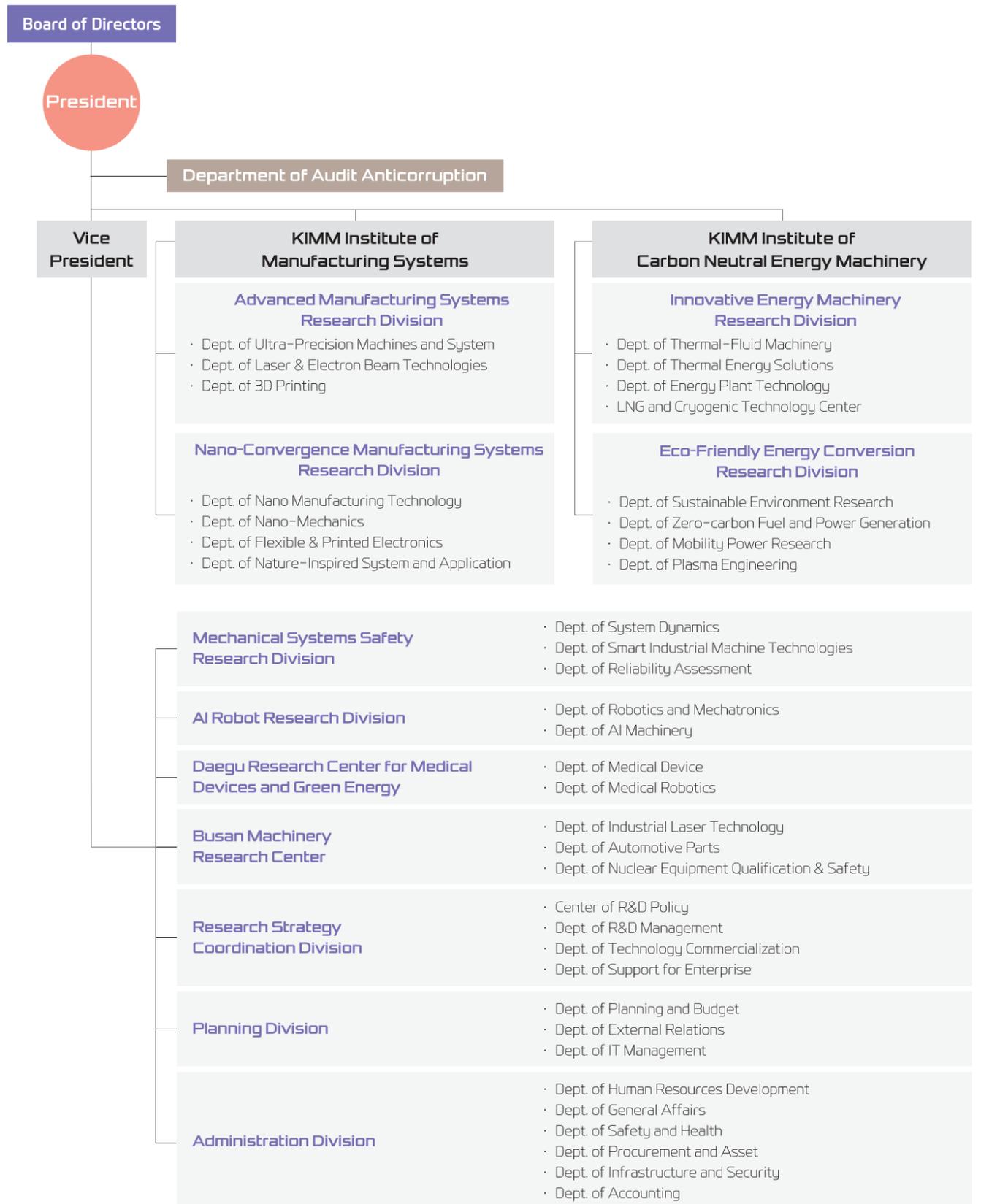
VISION & STRATEGY



Beyond the Technological Innovation SHIFT+

	SUPREME R&D FOR HUMANITY	INSPIRATION FOR FUTURE	TOGETHER +
STRATEGY	Conduct Effective Research for Humanity	Suggest the Future of Mechanical Technology	Together with Our Customers +
	<ul style="list-style-type: none"> Better, timely and flexible response to national issues Solving people's daily problems Expanding creative challenges 	<ul style="list-style-type: none"> Convergence-driven open Innovation Strengthening policy leadership in mechanical technology Systematic R&D planning with consumers 	<ul style="list-style-type: none"> Friendly research institute, intimate with people Commercialization-centered full technical support Creating voluntary innovation environment
CORE VALUE	Change & Challenge	Diversity & Collaboration	Respects & Care

ORGANIZATION



RESEARCH AREAS & MAJOR ACHIEVEMENT

10

KIMM INSTITUTE OF
MANUFACTURING
SYSTEMS

12

ADVANCED
MANUFACTURING
SYSTEMS
RESEARCH DIVISION

16

NANO-CONVERGENCE
MANUFACTURING
SYSTEMS
RESEARCH DIVISION

20

KIMM INSTITUTE OF
CARBON NEUTRAL
ENERGY MACHINERY

22

INNOVATIVE ENERGY
MACHINERY
RESEARCH DIVISION

26

ECO-FRIENDLY
ENERGY CONVERSION
RESEARCH DIVISION

30

MECHANICAL
SYSTEMS
SAFETY
RESEARCH
DIVISION

34

AI ROBOT
RESEARCH
DIVISION

38

DAEGU
RESEARCH
CENTER FOR
MEDICAL
DEVICES AND
GREEN ENERGY

42

BUSAN
MACHINERY
RESEARCH
CENTER

KIMM Institute of Manufacturing Systems

We raise the competitiveness of Korean manufacturing industry.

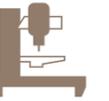
The KIMM Institute of Manufacturing Systems conducts research on the original technology and commercialization for manufacturing equipments, focusing on the smart advanced-manufacturing equipments for existing key industries as well as on the nano-convergence-based new future industrial manufacturing equipment. We also develop policies for the manufacturing equipment and support industries in all life-cycle.



Nano-Convergence Manufacturing Systems
Research Division



Advanced Manufacturing Systems
Research Division



ADVANCED MANUFACTURING RESEARCH DIVISION

We develop the state-of-the-art mechanical technology to make every industrial site smarter.

The Advanced Manufacturing Systems Research Division conducts research for manufacturing innovation based on ultra-precision positioning technology, energy beam processing technology, ultra-light high-power actuator, and additive convergence manufacturing technology. The technologies developed through this process form the core of manufacturing equipment such as next-generation processing systems, semiconductors, displays, 3D printing system, and general machinery.

ADVANCED MANUFACTURING SYSTEMS RESEARCH DIVISION



Department of Ultra-Precision Machines and Systems

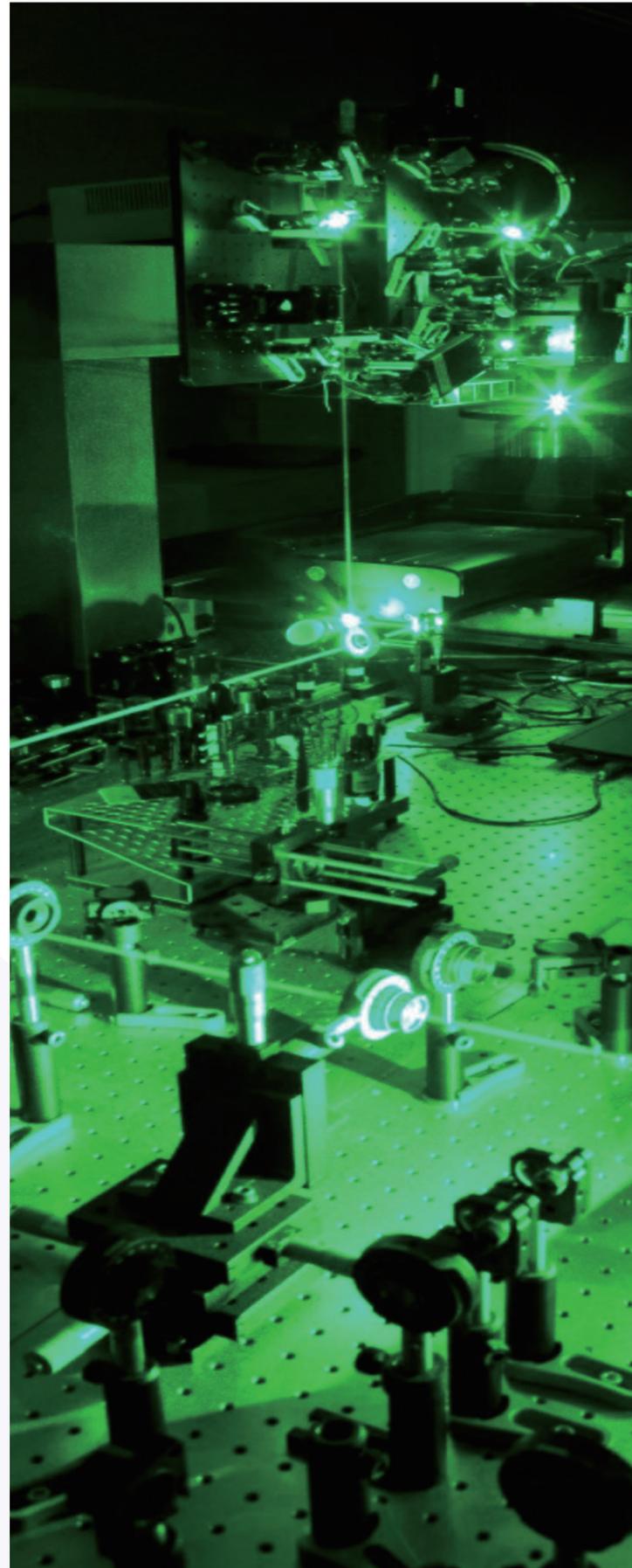
- Design and process technologies for ultra-precision machining systems
- IT-convergence and virtual simulation technologies for intelligent manufacturing equipment
- Manufacturing equipment and process technology for next generation electronic devices

Department of Laser & Electron Beam Technologies

- High power laser core modules and integrated system technology
- Laser · electron beam processes and system technology
- Optical measurement · diagnostic process and system technology

Department of 3D Printing

- Development of 3D printing core modules, systems and processes
- Design for Additive Manufacturing (DfAM) and evaluation
- 3D printing based convergence manufacturing



Major Achievements

Ultra-precision roll lathe to produce large-area micro-patterned optical films

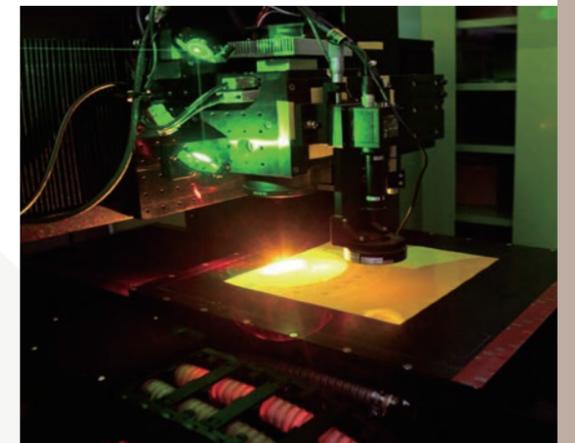
Representative example of commercialization in Korea's ultra-precision machine industry as equipment to produce large-area micro-patterned optical films

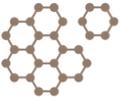
Real-time synchronization between a scanner and a stage for high-speed and high-precision laser machining of large-area substrates

Core technology enabling real-time synchronization between a laser scanner and a stage, which is important for laser micro-machines. This technology enables high-speed and high-precision processing (cutting, drilling, etc.) of large-area substrates such as flexible PCBs and display panels

Metal 3D printing system and process for large parts manufacturing and repair to improve functional performance of the products

Improving the functionality of press mold and defense parts through the development of metal 3D printing system and process technology





NANO CONVERGENCE MANUFACTURING SYSTEMS RESEARCH DIVISION

With nano-technology and machinery, we lay the foundation for a new industry.

The Nano-Convergence Manufacturing Systems Research Division aims to foster nano-convergence technology as a new future industry by developing the core technologies and conducting research for commercialization.

NANO CONVERGENCE MANUFACTURING SYSTEMS RESEARCH DIVISION



Department of Nano Manufacturing Technology

- Technologies for high precision machining process and equipment
- Technologies for micro/nanoscale imprinting forming process and equipment
- Technologies for Optomechanics based micro/nanoscale patterning and equipment

Department of Nano-Mechanics

- Technologies for design-measurement-reliability evaluation of nano-structure
- Technologies for equipments and manufacturing of nanomaterials and devices
- Technologies for modular equipments and manufacturing of meta-structures

Department of Flexible & Printed Electronics

- Printing, coating, and patterning processes and equipment technologies
- Core technologies for roll-based continuous production systems
- Flexible-stretchable printed electronic device manufacturing technologies

Department of Nature-Inspired System and Application

- Design of nature-inspired structures-functions and application technologies
- Fabrication of nanostructure-based functional surfaces and devices
- Bioprinting and self-assembly process-system technologies



Major Achievements

Step-and-repeat nano-imprint lithography (NIL) system and processing technology

Nano-imprint system and process technology for forming patterns by UV or thermal curing repeatedly or in multiple layers on a large area substrate using a nano-patterned stamp that precisely moves in steps

Original technologies for roll-based transfer techniques and related equipment for the Micro-LED display

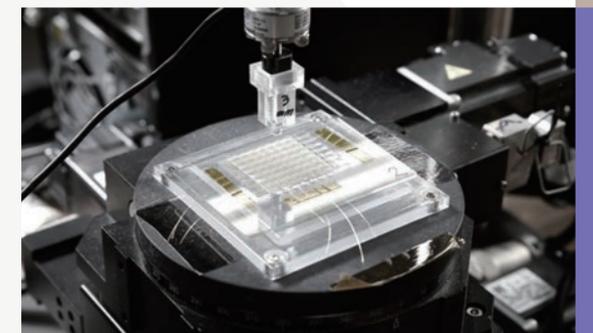
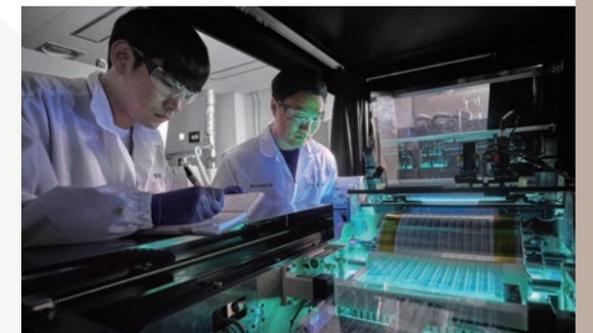
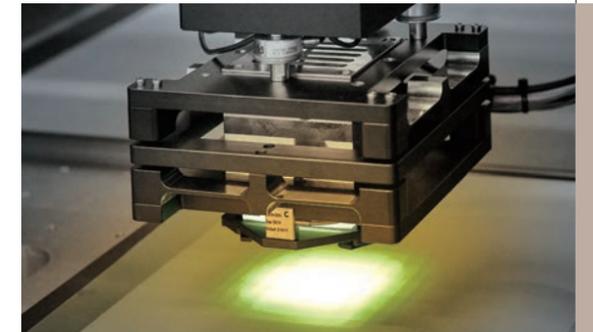
Original technology on the roll-based transfer techniques for transferring graphene and various nanomaterials, thin film devices (based on single-crystal silicon and other semiconducting composite, etc.) from a donor substrate to a flexible target polymer substrate

Roll-to-roll (R2R) fine pattern printing process and equipment technologies

Having a $1\mu\text{m}$ -grade of high precision micro-printing technology, it can manufacture cost-effective mass production of multi-functional devices such as flexible-stretchable displays, smart devices, and nano-thin film energy devices

Multi-functional nanostructure implementation technology based on nature-inspiration

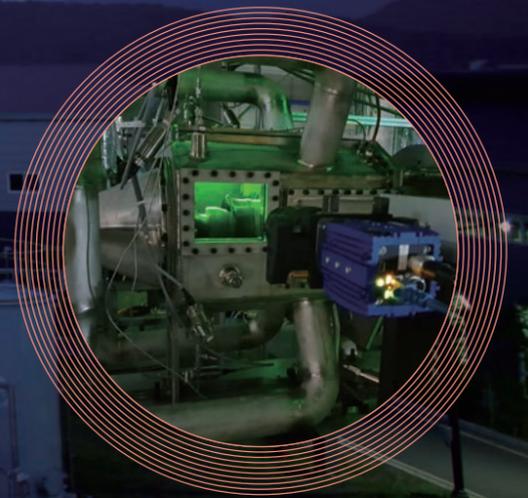
The development of design and manufacturing technology of multi-functional nanostructure such as antireflection in visible range based on biomimic of moth eye, superhydrophobicity-color surface using nano-metal-functional metal-oxide hybrid materials, and selective IR reflection based on metal nano-patterning



KIMM Institute of Carbon Neutral Energy Machinery

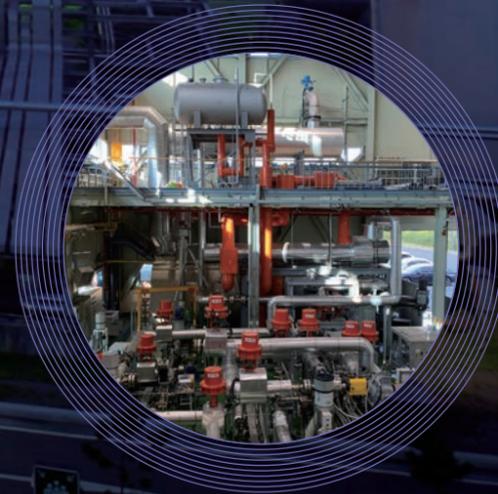
We lead the researches for the '2050 Carbon Neutrality'

The KIMM Institute of Carbon Neutral Energy Machinery conducts research on the proprietary technology and commercialization of core machinery for the production, conversion, storage and utilization of zero-carbon energy. As a national research institute, we also provide policy planning/development and industrial supports for the energy and environment areas.



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Eco-Friendly Energy Conversion
Research Division



Innovative Energy
Machinery Research Division



INNOVATIVE ENERGY MACHINERY RESEARCH DIVISION

We research on the energy technology for the future.

The Innovative Energy Machinery Research Division conducts research on thermal-energy conversion utilization system, large-capacity energy storage system, hydrogen liquefaction and liquid hydrogen storage/supply system to secure future carbon neutral energy technologies.

In addition, we develop thermo-fluid equipment such as compressors, pumps, turbines, heat exchangers and valves that are core machinery for these systems, as well as conduct performance evaluation and test certification.

Innovative Energy Machinery Research Division



Department of Thermal-Fluid Machinery

- Cryocoolers, cryogenic cooling systems, and liquefaction systems
- High efficiency fluid machinery
- Cryogenic Energy Storage Systems

Department of Thermal Energy Solutions

- Heat pump and HVAC technologies for carbon-neutral thermal systems
- Development of thermofluidic mechanical parts (heat exchangers, micro-reactors, sensors and actuators, etc.)
- Thermal process technology of energy plants and energy storage systems

Department of Energy Plant Technology

- Energy plant and renewable energy convergence technology
- Liquefied hydrogen system and equipment
- ICT convergent plant safety technology

LNG and Cryogenic Technology Center

- Performance test and evaluation technology for LNG and cryogenic equipment
- KOLAS certificate for the performance evaluation system of LNG and cryogenic equipment
- Research of LNG and cryogenic technology
- Technological support for companies



Major Achievements

Technology for low-vibration cryopumps for fast regeneration

Reduction of pump vibration and enhancement of reliability by applying a self-developed pulse tube cryocooler to cryopumps to create a high vacuum environment for semiconductor production equipment

High efficiency micro channel heat exchanger

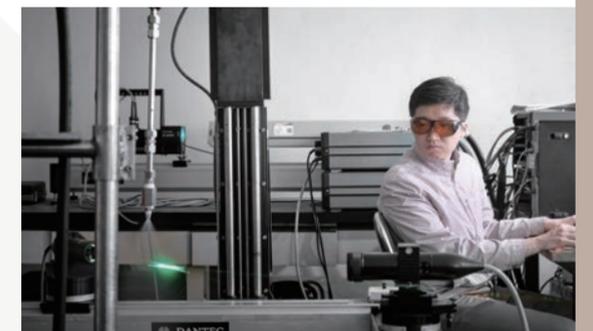
Design, manufacturing, and evaluation technologies for performing stable and efficient heat transfer under extreme environments such as cryogenic, ultra-high temperature and pressure conditions.

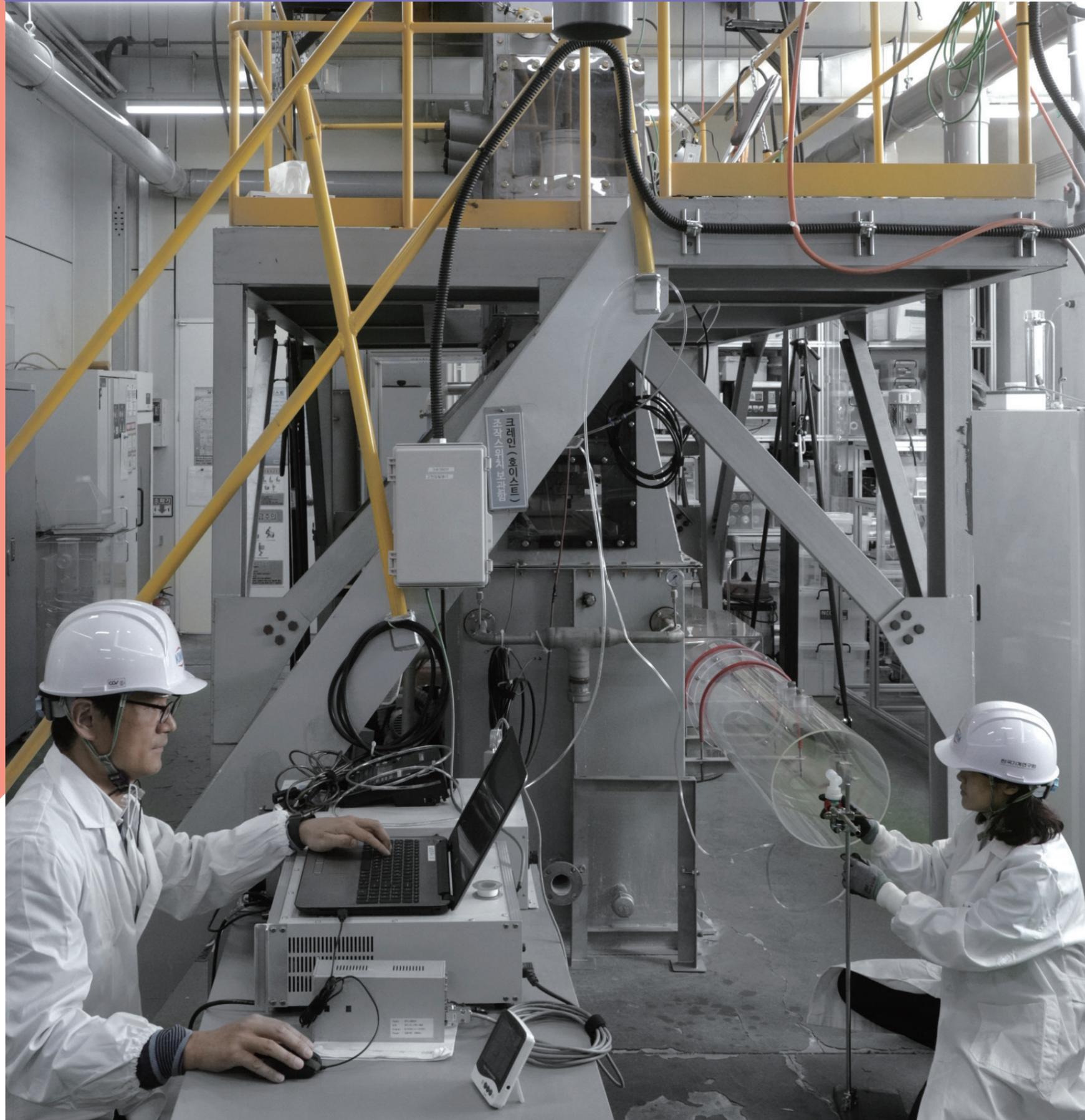
Hydrogen liquefaction plant process and core equipment

Hydrogen liquefaction process, core equipment (cryogenic heat exchanger/turbo expander/cold box/liquid hydrogen storage tank) and plant design-construction-operation technology development

Performance evaluation system of core equipment for LNG carriers and plant

Korea's first performance evaluation system of LNG and cryogenic equipment such as cryogenic pumps and valves, the core equipment for LNG carriers and plants





ECO-FRIENDLY ENERGY CONVERSION RESEARCH DIVISION

We lead in developing eco-friendly energy technology for the Earth.

The Eco-Friendly Energy Conversion Research Division researches the high efficient and clean environmental technologies to cope with air pollution, global warming and other environmental issues. Our division has the core environmental technologies in plasma, air · water treatment, gas turbines, engines, combustors, and so on; based on these technologies, we are developing highly-efficient and environmentally friendly power generation systems for the future.

Eco-Friendly Energy Conversion Research Division

Department of Sustainable Environment Research

- Air pollution reduction technologies for fine particles, hazardous gases and bio-aerosols
- Air pollution exposure control technologies for personal protection
- Harmful gas treatment technologies in low carbon power plants
- Advanced technology for water purification and waste water treatment
- Membrane-based desalination

Department of Zero-carbon Fuel and Power Generation

- Low emission combustor for power- & aero-gas turbine
- Fuel cell / electrolysis system and BOP technology
- Sustainable agricultural energy system technology
- Chemical recycling / energy recovery of biomass and waste

Department of Mobility Power Research

- Carbon-free fuel power system development
- After-treatment of mobility exhaust and non-exhaust emissions
- Core part technology for carbon-free fuel supply system
- High efficiency mobility power device technology
- Mobility waste heat recovery and utilization technology

Department of Plasma Engineering

- Energy conversion · storage · resource technologies using plasmas
- Environmental technologies for reducing fine particle · odor · pollutant
- Chemical conversion and processing technologies
- Semiconductor-Display manufacturing and plasma process · equipment technologies for environmental devices
- Emerging industries (medical, public health, agri-food, etc.) with plasma application



Major Achievements

Electrostatic mist eliminator to reduce fine particles emitted in coal-fired power plants

Improvement of particle contaminants removal efficiency by more than 10 times using the eliminator with high-flow rigid discharge electrodes electrostatic precipitation

Domestic development of low emission gas turbine combustor for large-scale industrial power plants (reducing NOx and ultrafine particles)

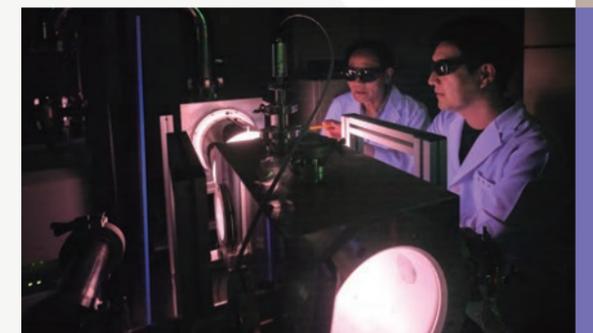
Korea's first practice of commercializing gas turbine combustors for large-scale power plant applications to improve fuel mixing of gas turbine burners and prevent combustion instability through detailed design of burners

H2 direct injection engine

By directly fueling H2 to the combustion chamber of an engine, more than 30% of power increase can be achieved resolving abnormal combustion problems compared to port fuel injection

Low-pressure plasma technology for eco-friendly semiconductor processing

An innovative technology that reduces pollutants emission from the semiconductor processing by applying a plasma reactor before a vacuum pump. It enables eco-friendly processing, preventing safety-related accidents and extending the lifespan of vacuum pumps in the processing lines





MECHANICAL SYSTEMS SAFETY RESEARCH DIVISION

We add safety and reliability to large, complicated mechanical systems.

The Mechanical Systems Safety Research division concentrates on the development of core technologies for the design and engineering of large and complex mechanical systems, integrated systems technology, and new mechanical systems, using safety and reliability technologies. Its main research areas include urban or high-speed magnetically-levitated trains, wind turbine systems, dynamic modeling and simulation (M&S), and control technologies, as well as safety and reliability technologies for mechanical and structural systems.

MECHANICAL SYSTEMS SAFETY RESEARCH DIVISION



Department of System Dynamics

- Modeling and simulation for acoustics, vibration, and shock analysis
- Rotor dynamics and tribology
- Condition monitoring, diagnosis, and prognosis for mechanical systems
- Dynamic analysis · control and evaluation technology for complex mechanical systems
- Improvement of integrated survivability of naval vessels
- Immersive spatial sound technology for digital transformation

Department of Smart Industrial Machine Technologies

- Off-road autonomous driving and operation
- Virtual testing for autonomous systems
- High-speed and lightweight drivetrain
- Structural safety and optimization

Department of Reliability Assessment

- Development of reliability assessment system · reliability standards
- Accelerated life test design, failure analysis and prognostics, system reliability prediction technology
- General performance, environmental, safety and life test
- Development of CPS-based unified · autonomous technology for digitalization of reliability engineering
- Engineering for the reliability improvement in the overall life cycle of emerging industry products



Major Achievements

Artificial intelligence-based diagnosis · prognosis and damage management technology

Development of AI-based technology for predictive maintenance and damage management for industrial plants

Naval ship survivability enhancement design

Development of integrated survivability analysis and assessment processes to reduce susceptibility and vulnerability, and increase recoverability of naval ships. Applied and contributed to the survivability design improvement of ROKN ships.

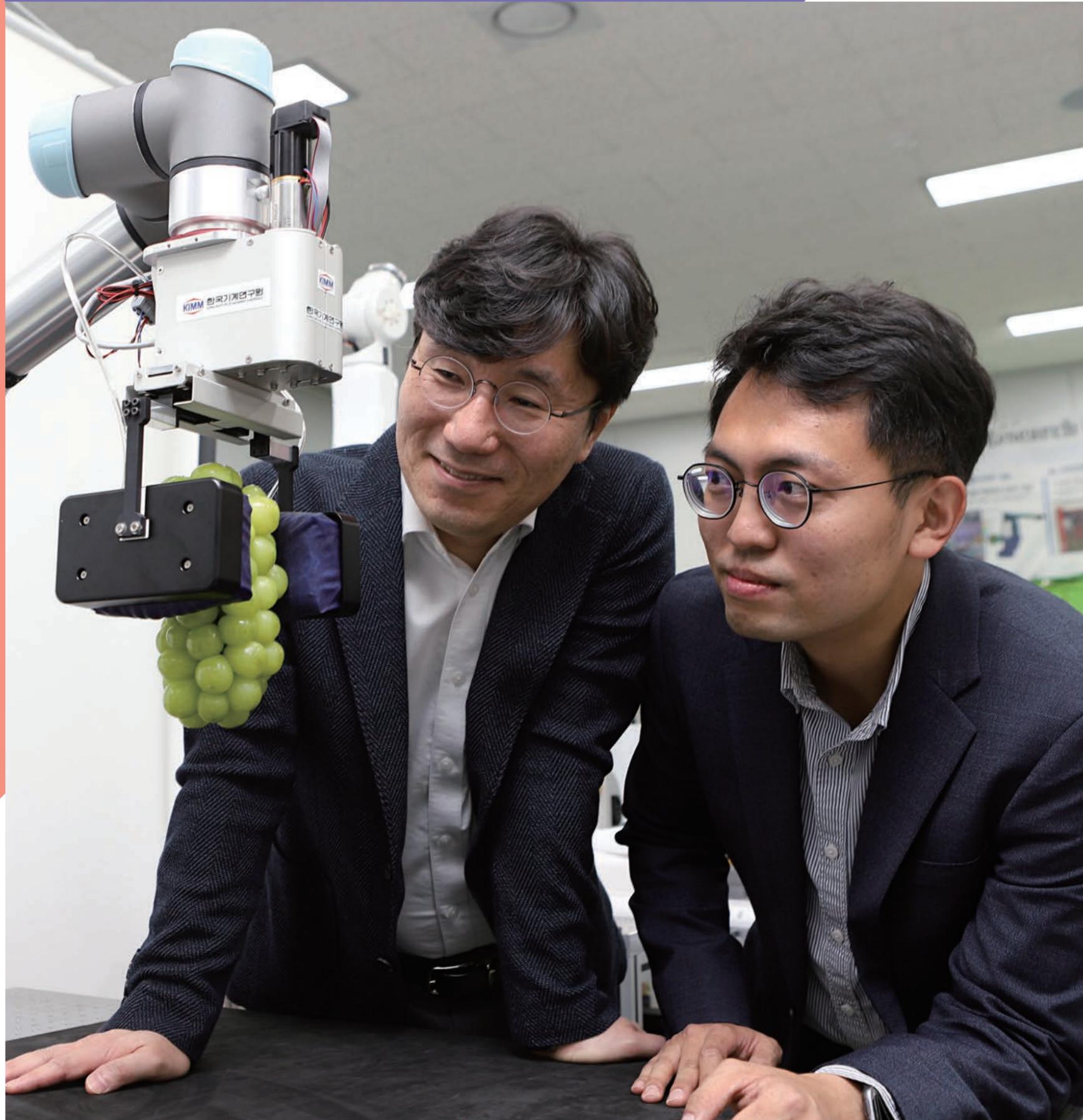
Autonomous driving of agricultural tractor

A low-cost sensor-based cm-level position and orientation estimation method for self-driving tractor was developed, and a digital twin-based virtual test secured the safety and reliability of the autonomous system prior to the field test

Technology for acquiring reliability-based competitiveness of domestic mechanical and mechatronics parts · equipments

Total technology-support services ranging from reliability assessment, analysis and certification are being provided, as well as the unified autonomous reliability engineering platform technology developed to achieve CPS-based digital unification · autonomy of reliability technology





We are developing intelligent robot technology that will enrich the future of mankind.

For a future where humans and robots coexist, we are developing AI-based autonomous manipulation technology for the next generation robots, human-robot cooperation technology, key component technology that determines the performance of robots, innovative design technology and robot application technology using it.



Department of robotics and mechatronics

- Next generation industrial robot & human-robot cooperation technology
- Wearable robot & human support robot technology
- Innovative robot design & robot core parts technology
- Robot application & industrial process standardization technology

Department of AI Machinery

- AI-based mechanical systems
- Logistics robot capable of autonomous manipulation
- AI technology for public safety
- Magnetic levitation and linear drive technology



Major Achievements

Robot core parts for next-generation robots

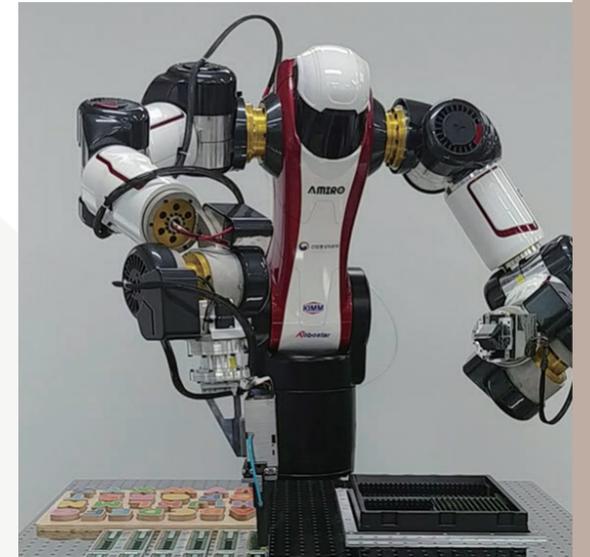
Robot core parts developed to secure the competitiveness of future robots, such as the all-round gripper capable of handling objects of all shapes, the robot hand capable of handling everyday tools, the artificial muscle-based cloth-type actuator for the implementation of a suit-type robot and the harmonic reducer design & performance prediction software

Multi-arm robot technology for high-difficulty tasks

In order to develop robots that can perform difficult tasks that cannot be implemented using existing robots, we developed dual-arm robot technology that can perform assembly tasks using both arms like a human and we also developed an intelligence-based control technology for multi robots that can handle parts that change shape, such as cables.

AI-based autonomous technology for mechanical systems

AI-based autonomous technology development for mechanical systems that can move by itself in dynamic and unstructured environments and perform various tasks such as transferring goods, using tools, and collaborating with humans and robots





DAEGU RESEARCH CENTER FOR MEDICAL DEVICES & GREEN ENERGY

Our medical device technologies can make people's lives more prosperous.

The Daegu Research Center for Medical Devices and Green Energy focuses on researches associated with medical devices and medical robots with an aim to improve the quality of people's life, and also to play an important role in advancing medical technology and promoting mechanical-manufacturing industry of Daegu-Gyeongbuk region in accord with government policy.



Department of Medical Device

- On-site diagnosis platform for rapid and automated disease detection
- All-in-one cartridge system integrated with microfluidic control technology for molecular diagnosis
- Bio-chip and bio-sensor design · fabrication technology
- Analysis of biosignals and biomechanics

Department of Medical Robotics

- Mechanisms and actuators for rehabilitation and surgical robots
- High-precision and high-sensitive medical robot control
- Tele-operated medical robots
- Physical assistant robots



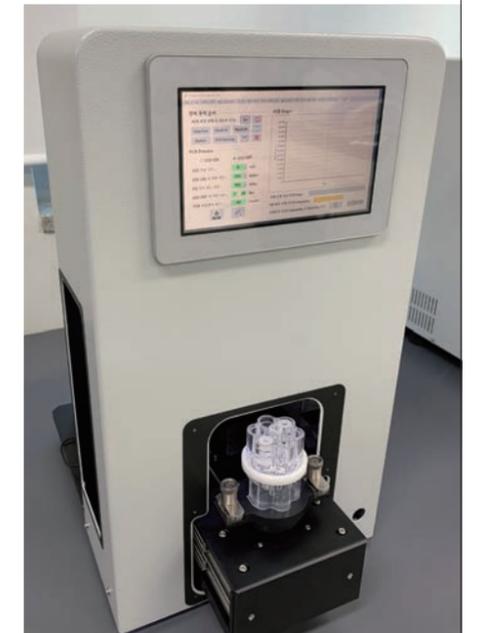
Major Achievements

"Point-of-care (POC)" molecular diagnostics system

A fully automatic device for nucleic acid extraction, amplification, and detection, which carries all-in-one molecular diagnostic cartridges with all the necessary reagents for fast and accurate on-site disease inspection

Ankle-type robotic prostheses for amputees

Ankle-type robotic prostheses to enable natural walking with light weight by controlling the torque and angle of the ankle joints





BUSAN MACHINERY RESEARCH CENTER

We thrive to achieve technological advancement of industries in the southeastern area.

The Busan Machinery Research Center tries to achieve high added value in the mechanical parts and materials industry by distributing laser processing technology, automotive parts technology, and nuclear power plant safety technology to local companies and performing test certification support.



Department of Industrial Laser Technology

- Development of laser processing technology
- Development of high-energy beam processing technology
- Design of laser optics modules and systems
- Industrial technology support and transfer

Department of Automotive Parts

- Eco-friendly powertrain & emission control technology
- Electrized parts and control
- Certification for automotive parts
- Technical support for HEV, EV, FCEV and their parts

**Department of Nuclear Equipment
Qualification & Safety**

- Nuclear equipment design, qualification, safety evaluation technologies
- Nuclear power plant decommissioning and radioactive waste related machinery technology



Major Achievements

Multi-beam laser fusing system for highly functional thermal spray coating

Multi-beam laser fusing technology for manufacturing high-performance molds

•**Multi-beam laser fusing technology** Using a large area preheat beam, heat treatment beam combination and non-contact temperature control system as a homogenized laser heat treatment method enhanced the mechanical performance of the mold coating layer

Development and demonstration of aftertreatment system for transfer crane

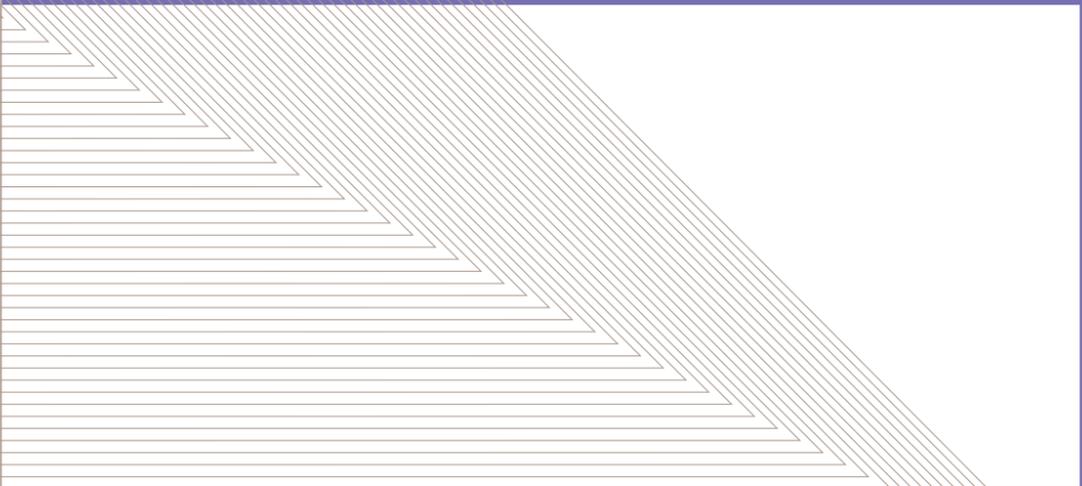
Aftertreatment system which reduce above 80% of PM and PN, 85% of NOx was developed and installed in the transfer crane of Busan port

Nuclear power plant severe accident simulation test technology

Establishment of evaluation standard of equipment survivability technology for the severe accident, based on the collaboration with nuclear power plant operation and design groups



TECHNICAL SUPPORT & EXTERNAL RELATIONS



48

TECHNICAL
SUPPORT

49

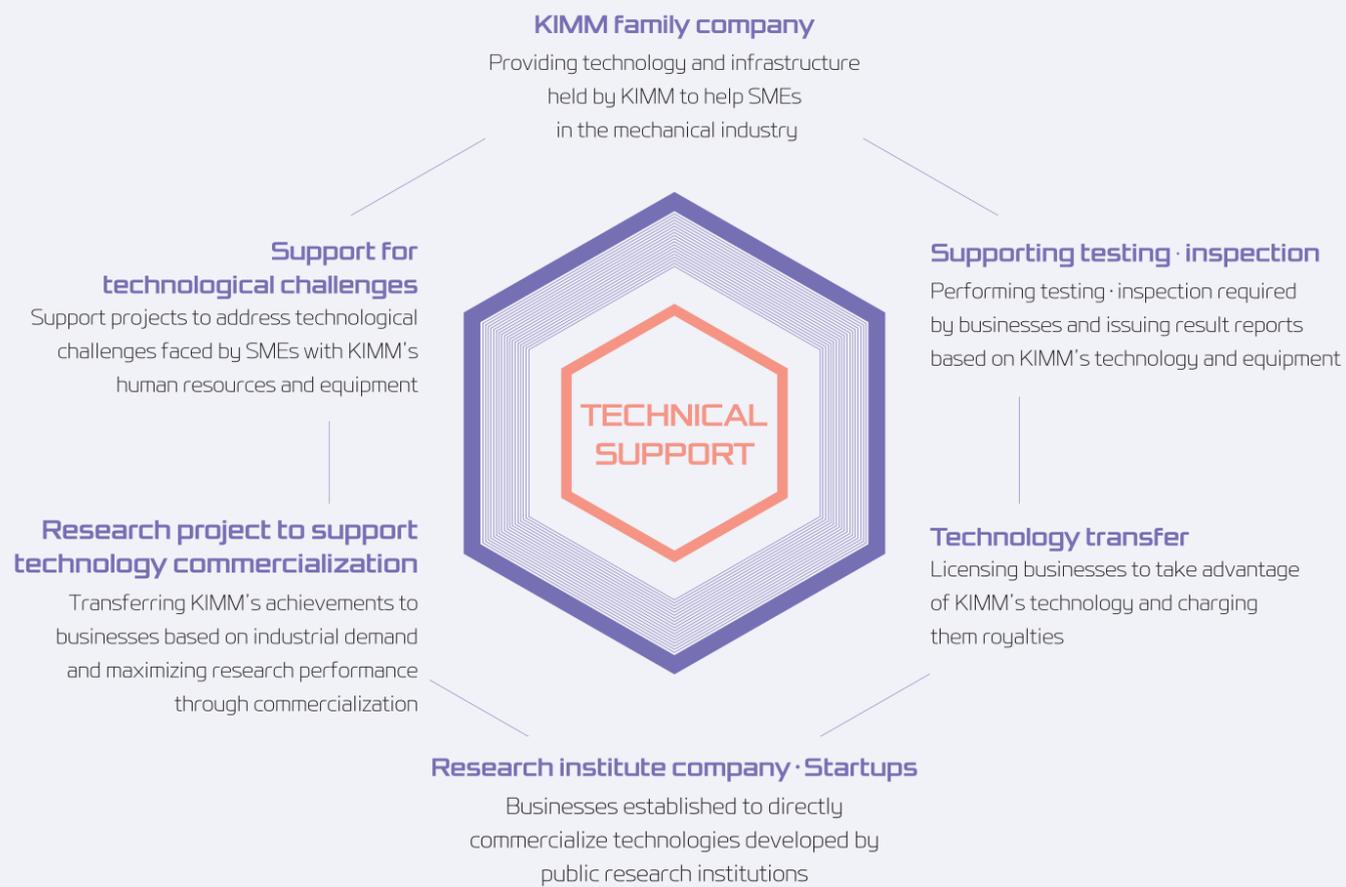
INTERNATIONAL
COOPERATION

50

SOCIAL
CONTRIBUTION

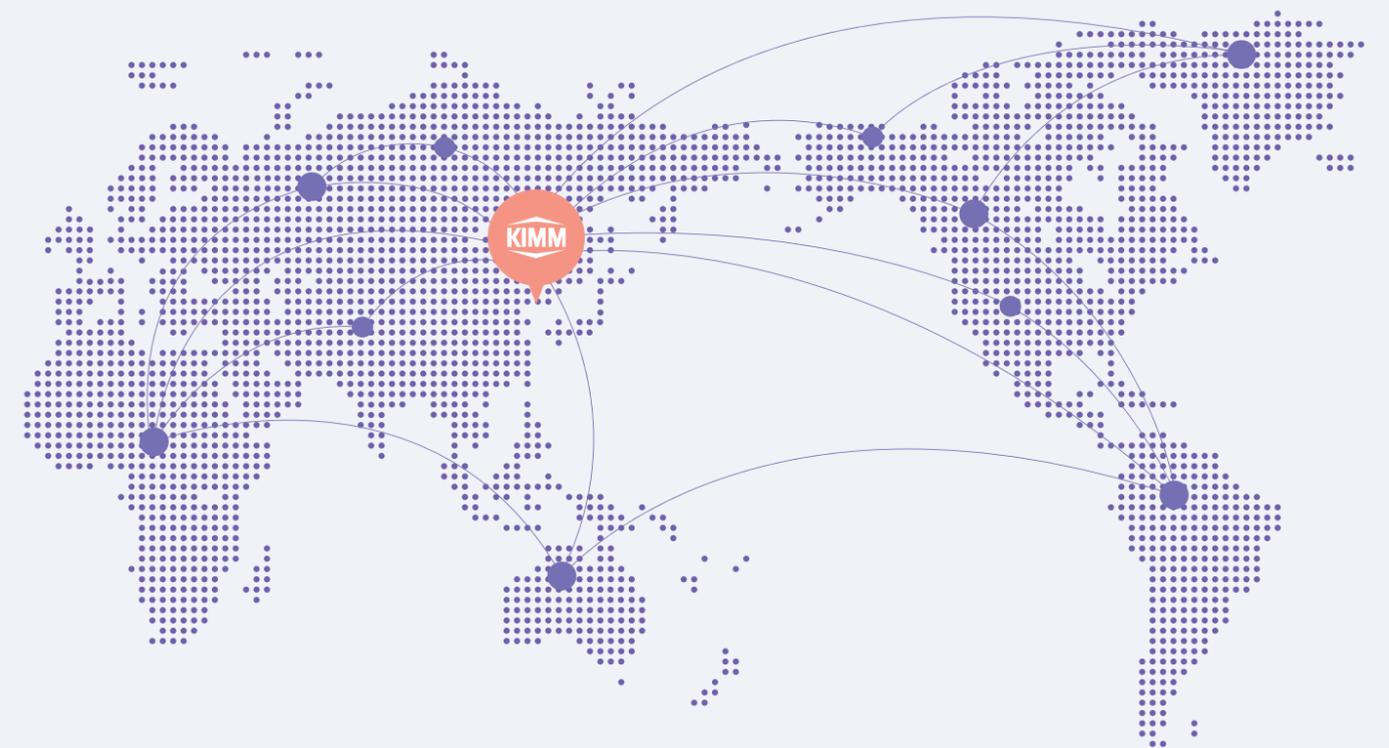
TECHNICAL SUPPORT

We develop outstanding mechanical technology to lead the future and help such outcomes become established in industry and economically.



INTERNATIONAL COOPERATION

We are reaching the rank of global research institutes by securing source technology and producing global research groups.



SOCIAL CONTRIBUTION

We fulfill our social responsibility and promote a culture of sharing.



KIMM Science School



Educational donation



Volunteer activities for rural communities



Science mentoring program



Donation to a local welfare foundation (Science Kits)



Sharing kimchi for the winter



Korea Science Festival

KIMM has endeavored to ensure development of Korean industries by developing source technology for the future, leading innovation based on technical integration and convergence, and creating open research environments. We are committed to bringing a better future for Korea based on continued technological innovation.



KIMM CHARACTERS
'Eddie & Buddles'



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DATE OF PUBLICATION

March 2023

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This book is printed with eco-friendly paper and
soybean oil to protect the environment.