

# Promotion of Creation and Co-creation of Innovation with Vacuum Technology as the Core

## Development Policy

We are promoting innovative research and development focused on vacuum technology, with the ultimate objective of realizing a sustainable society. In view of recent investment in the development of advanced semiconductors and electronic devices around the world, we have decided to take on the challenge under a new structure geared to co-creation with customers. Spearheading our initiatives is the Research & Development HQ, a new organization established in July 2023. Consist of three organizations, the Institute of Advanced Technology, Future Technology Research Laboratory, and Software Development Department, the Research & Development HQ promotes R&D of the entire ULVAC Group to maximize R&D resources and results. For this purpose, the Research & Development HQ collaborates with other divisions and group companies to plan, formulate, and promote development strategies.

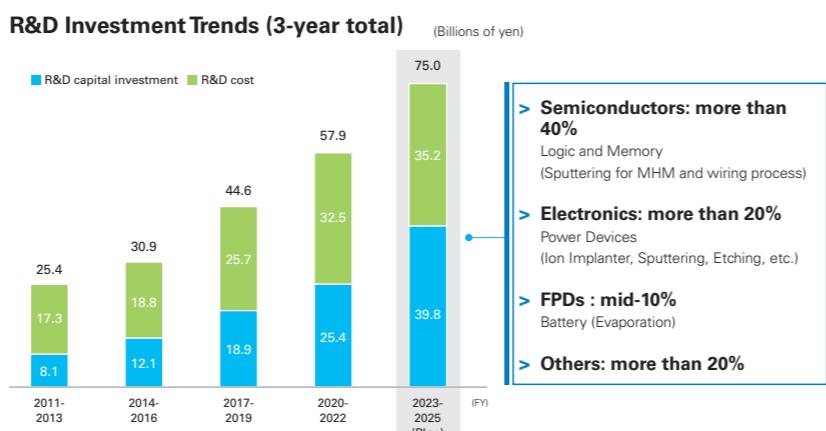


**Junya Kiyota**  
Senior Executive Officer  
Research &  
Development HQ

## R&D Investment Policy

Our aim is to strengthen the three semiconductor fields that will be growth drivers: logic, memory, and power devices. In the logic and memory fields, based on our experience with metal hard mask processes in the cutting-edge logic field, we are developing equipment that will enable our entry into other processes and we are also improving the performance of deposition processes. In the memory field, in line with the progress of miniaturization and ever-higher integration, we are developing equipment for DRAM and 3D NAND flash memory with the aim of entering other processes, while also developing deposition processes. In the power device field, which is attracting attention in view of its potential contribution to energy saving, we are emphasizing the development of ion implantation systems.

In the logic and memory fields, the complexity of manufacturing technology is rapidly increasing. Therefore, in order to succeed in the market, it is essential to collaborate ever-more closely with manufacturers of advanced semiconductors. Against this backdrop, construction of Technology Center PYEONGTAEK is underway (scheduled for completion in March 2024) to further strengthen ULVAC's foundation for further development in South Korea. The Technology Center's mission is to accelerate product and technology development near customers and enhance collaboration and technical support.



### Overview of Technology Center Pyeongtaek

Location:	1029, Yulbul-ri, Cheongbuk-eup, Pyeongtaek-si, Gyeonggi-do
Construction began:	March 2023
Construction scheduled to be completed:	March 2024
Site area:	Approximately 11,550 square meters
Building area:	Approximately 13,168 square meters (including clean room area of approximately 2,008 square meters)
Investment amount:	Approximately 6 billion yen

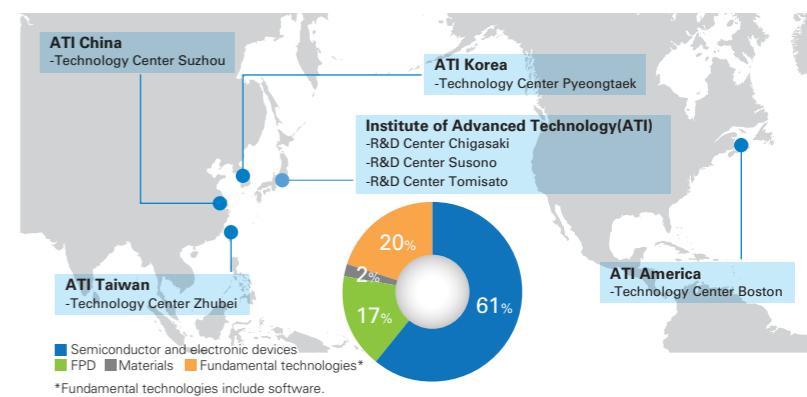
## R&D Structure

### Strengthening of the R&D Strategy

In the semiconductor and electronic device fields, which are our priority fields, we have reallocated resources. The R&D Center will conduct next-generation product development and basic R&D to acquire basic IP while the Technology Center will swiftly promote product and technology development by deepening collaboration with customers and provide technical support. By enabling development meeting the needs of each product and region, this new structure will maximize development outcomes.

### Integration of the Group's R&D functions

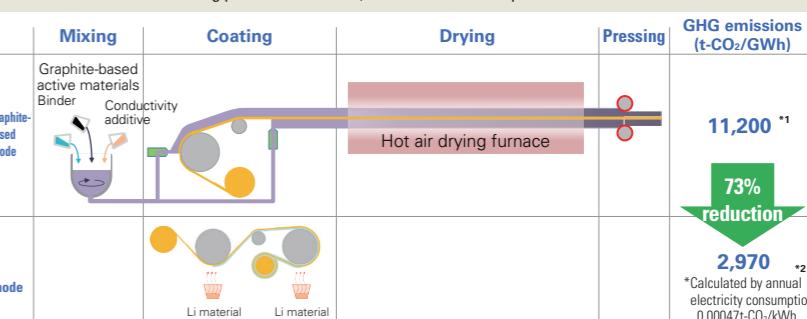
By integrating the R&D structure of the entire Group, we aim to continually create differentiated products and new technologies, acquire IP, and accelerate development. In this way, we will establish and operate a system that will continue to provide cutting-edge products and technologies in a timely manner in response to customer requirements. The Research & Development HQ will play a central role in releasing advanced technologies that enable us to quickly address social issues for the benefit of society.



## Green Innovation

Large quantities of greenhouse gas (GHG) emissions, which are a consequence of the development of the global economy, are causing global warming. In order to solve this major environmental problem, developed countries have declared their intention of achieving carbon neutrality and are implementing various greening measures. In particular, with CO<sub>2</sub> emissions from the use of automobiles currently accounting for 16% of global GHG emissions, the trend toward electrification of automobiles is accelerating. However, due to the constraints on car body design and considering the cost, more compact and lightweight storage batteries are needed to spur mass adoption of electric vehicles. ULVAC will capitalize on its prowess in vacuum technology in the development of new technologies for the manufacture of compact and lightweight storage batteries, thus creating innovation leading to resolution of social issues. Specifically, we are developing production technology for lithium metal anodes by applying vacuum technology to achieve social implementation of high-energy density storage batteries with lithium metal anodes. In collaboration with manufacturers of parts and materials, film processors, etc., applying the deposition technology of roll-to-roll vacuum lithium evaporation equipment for mass production, we will offer equipment capable of producing thin-film, high-purity lithium anodes at low cost, thereby contributing to realization of more compact, higher-capacity storage batteries and reducing GHG emissions. ULVAC's lithium metal anode production technology was adopted by the New Energy and Industrial Technology Development Organization (NEDO) as a "development of material technologies for next-generation storage batteries" theme in the area of R&D of "high-performance storage batteries and materials" under the "Next-generation Storage Battery and Motor Development" project of the Green Innovation Fund Projects.

By changing the anode from graphite to Li, the conventional manufacturing processes of mixing, drying, and pressing are no longer necessary, and a 73% reduction in GHG emissions can be expected. Since the Li anode manufacturing process is electrified, fossil fuels are not required.



\*1 Source: "EU Competitiveness in Advanced Li-ion Batteries for E-Mobility and Stationary Storage Applications – Opportunities and Actions," 2017

\*2 Substitute value for emission factor by electric utility operator (for calculation of GHG emissions of specified emitters)

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### ULVAC-Osaka University Joint Research Laboratory for Future Technology

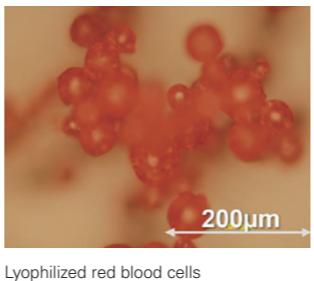
ULVAC, Inc. established ULVAC-Osaka University Joint Research Laboratory for Future Technology within Osaka University and is promoting the following studies through industry-academia co-creation with the aim of creating innovation.

#### ① Development of Next-generation Semiconductor

Innovative semiconductor technologies are expected to constitute the foundation of the future information society. Research is underway around the world into photoelectric fusion device, the next-generation optical semiconductor devices expected to enable high-speed communication and low power consumption. The ULVAC-Osaka University Joint Research Laboratory for Future Technology is researching photonics-spin convergence semiconductor devices, which are photoelectric fusion device that exploit the degree of freedom of spin of electrons. This technology has the potential to transcend the issues constraining development current semiconductor devices, such as the process scaling limit and heat generation, to achieve higher information density. ULVAC also aims to create new processes and materials facilitating application of advanced vacuum deposition technology in the semiconductor industry.

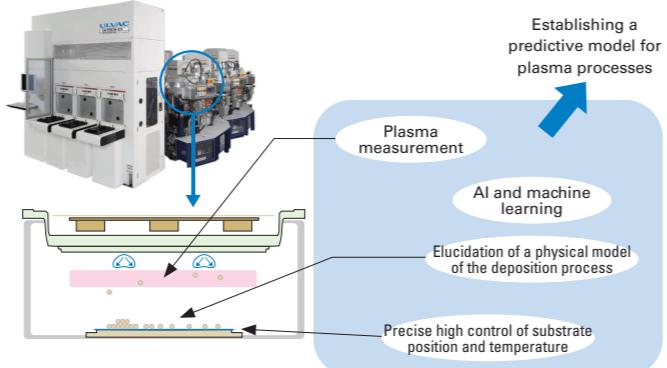
#### ② Medical-engineering collaboration

The ULVAC-Osaka University Joint Research Laboratory for Future Technology is conducting research in the medical field in which it is applying vacuum technology. Using vacuum deposition technology, the Lab is focusing on circularly polarized light sources for medical equipment applications and, using vacuum drying technology, on storing of living cells and pulverization of pharmaceuticals. In particular, the Lab is collaborating with the Faculty of Medicine, Osaka University, to develop a lyophilization technology for storing living cells in powder form using ULVAC's proprietary Micro Powder Dry™ spray-freeze-drying technology, which utilizes the phenomena of water self-freezing and ice sublimation in a vacuum. If application of this technology realizes pulverization of blood, it will enable long-term storage of living blood cells for immediate use, leading to the further development of medicine.



### ULVAC Advanced Technology Collaborative Research Cluster

The ULVAC Advanced Technology Collaborative Research Cluster (hereinafter "Collaborative Research Cluster") was established by ULVAC, Inc. and Tokyo Institute of Technology (hereinafter "Tokyo Tech") on the Okayama Campus of Tokyo Tech on September 22, 2021. Joint study is underway, combining Tokyo Tech's plasma diagnostics technology and AI technology, with the aim of improving the performance of ULVAC's plasma processing equipment by measuring plasma conditions that could not be measured previously. In the course of the past two years, we have cultivated collaborative relationships with five more laboratories which are engaging in joint research with us and providing academic guidance, not only with respect to plasma measurement and AI, and are addressing new basic research themes with a view to improving the performance of our equipment. Good results are being achieved as evidenced by presentations at academic conferences in Japan and abroad and the submission of papers. Active discussions were held among the joint research reporting meeting and we will deepen collaboration with the aim of producing new research results that cannot be obtained through ad hoc collaborative research, but are the fruits of the synergy created by laboratories from different fields working together. Leveraging this organization-to-organization collaboration, we would like to strengthen a wide range of relationships, not only in joint research but also in fields such as personnel development, leading to future growth of both ULVAC and Tokyo Tech as well as technological innovation.



### Intellectual Property Assets

As a pioneer of vacuum technology in Japan, the ULVAC Group has accumulated intellectual property rights and knowhow in many vacuum-related fields over the past 70 years. The vacuum-related intellectual property assets accumulated within ULVAC, ranging from technologies for equipment, such as vacuum freeze-drying equipment for pharmaceutical applications and semiconductor manufacturing equipment to materials technologies, are expected to be applied to new technologies in the future. With vacuum technology at its core, the ULVAC Group will continue to create and utilize intellectual property assets for the advancement of industry and science.

#### Basic Policy on Intellectual Property Assets

The basic policy on intellectual property assets is "to develop and enhance the business environment, strengthen the competitiveness of the entire ULVAC Group, and enhance corporate value through intellectual property assets." To accomplish this basic policy, we are implementing four measures.

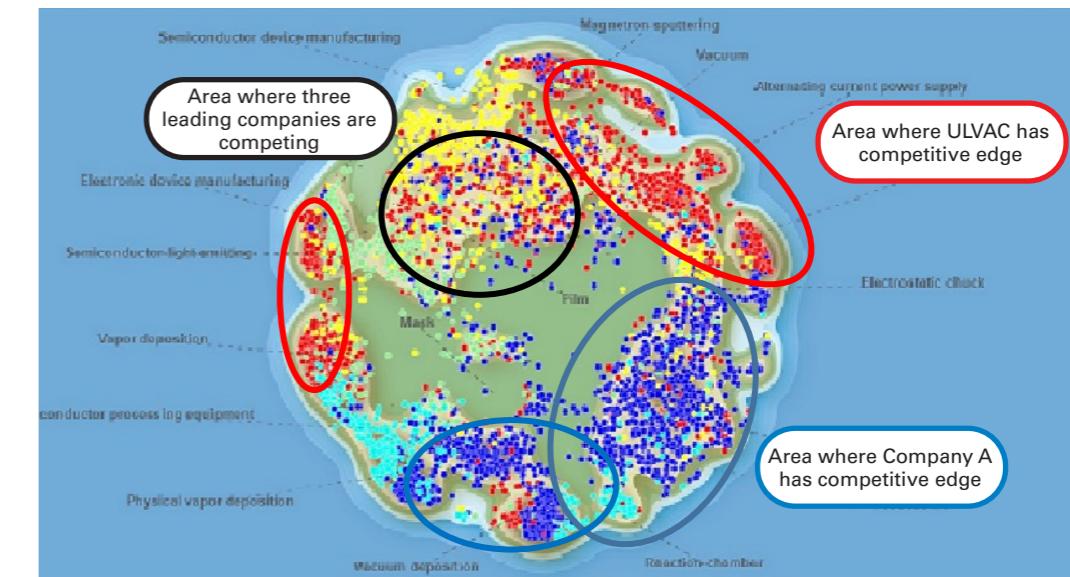
1. Respect intellectual property rights of other companies
2. Utilize intellectual property marketing (IP landscape) for management
3. Integrate business, development, and intellectual property strategies (trinity strategy)
4. Promote utilization of intellectual property and collaboration through centralized management of intellectual property of the entire Group

#### Intellectual Property Strategy Design

Our IP grand design covers not only patent application planning but also consideration of market trends, the value chain (from product design to disposal), ESG factors, such as energy saving, environmental impact, and social responsibility, and revenue-generating business models.

Such a comprehensive IP strategy facilitates innovative inventions and deployment of development outcomes in the marketplace, and contributes to acquisition of IP rights with clear objectives.

#### Example of IP landscaping for technology distribution



#### Intellectual Property Governance Structure

The Intellectual Property Strategy Committee has been established as an organization to discuss Group-wide IP strategies. The committee is chaired by the director in charge of innovation and is working closely with the Board of Directors. Membership of the committee comprises those people responsible for development departments, divisions, and Group companies. In formulating intellectual property strategies, the committee adopts a bird's-eye view of the entire Group.

For details Website >> Research and Development > Intellectual Property Assets (Japanese only)