

# Review of Operations

## Material Business

Manufacturing and sales of electronic functional materials and high-purity chemicals



TOK Taiwan Co., Ltd.



TOK Advanced Materials Co., Ltd. (South Korea)

### Material Business Performance

(Millions of yen)

	FY 2018/12 Result	FY 2019/12 Result	FY 2020/12 Result	
			Change	%
Net sales	102,621	98,986	114,773	+15,787 +15.9%
Electronic functional materials	58,793	58,249	65,878	+7,629 +13.1%
High-purity chemicals	43,733	40,674	48,732	+8,058 +19.8%
Other	95	63	161	+98 +154.7%
Operating income	14,765	13,462	20,395	+6,933 +51.5%
Operating margin	14.4%	13.6%	17.8%	— —
Segment assets	104,125	113,079	119,695	+6,616 +5.9%
Depreciation and amortization	6,852	7,009	6,518	(491) (7.0%)
R&D costs	7,856	8,370	9,093	+723 +8.6%

### Risks and opportunities—Material Business—

#### Risk

- Rising cost of development due to increasing technological difficulties
- Unfavorable market environment due to the escalating geopolitical risks that include the U.S.-China trade friction
- Interruption or confusion of supply chain due to the increased climate change risks and infectious disease risks
- Increased investment outlays for inspection and production equipment in connection with ultrahigh purification
- Impact of higher costs of equipment following advances in exposure equipment and miniaturization
- Impact of decrease in customers, with the same number of photoresist manufacturers
- Impact of over-concentration of main business domains in the electronics industry

#### Opportunities

- Increasing needs for ultra-miniaturization (EUV and ArF photoresists)
- Growing needs for cutting-edge packaging technologies (2.5D, 3D semiconductor packaging)
- Further increase in data volume and semiconductor needs due to 5G, IoT, and AI
- Increase in semiconductor needs due to the accelerated global initiatives for decarbonization
- Expansion in business opportunities through the global structure of close relationships with customers (in Japan, the U.S., South Korea, and Taiwan), and multi-site systems at major customers
- Capture growth opportunities through strengths in both the front-end process and back-end process of semiconductor manufacturing
- Increase in proposal opportunities for semiconductor manufacturing processes due to further diversified needs in both materials and equipment (synergies with Equipment Business)

### Issues for Society and Customers and TOK's Solutions

#### Contribute to innovation by achieving the combination of high performance, high quality, and stable supply

In addition to conventional functionality as the heart of electronic equipment, semiconductors have become essential supplies for leading innovation and for resolving highly complex social issues that face humankind, such as the climate change risks and infectious disease risks that have recently become apparent.

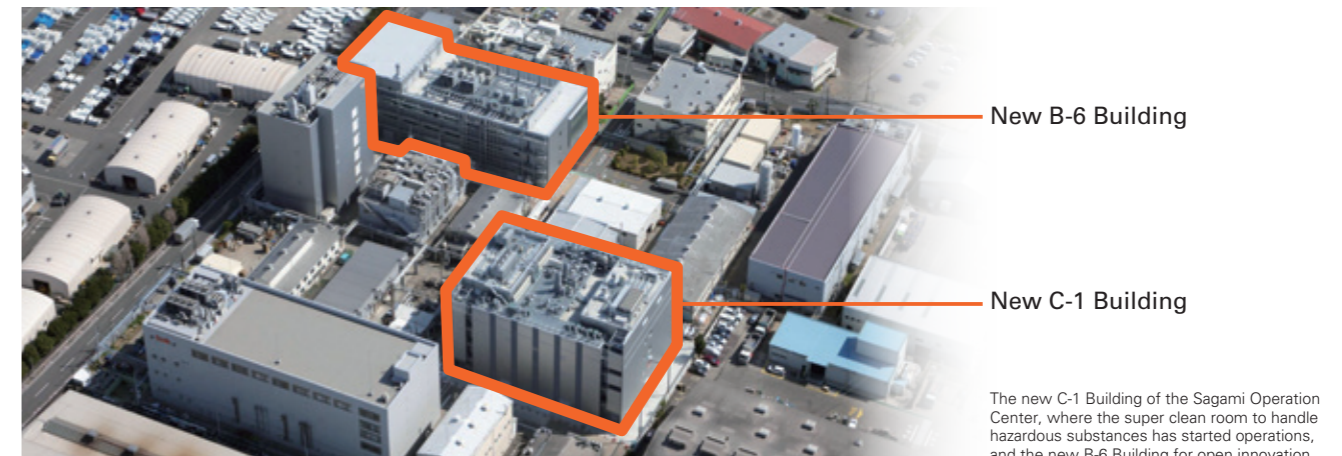
We consider this the mission of the semiconductor-related industries, including TOK, to contribute to achieving the higher performance, downsizing, lower power consumption, and cost reduction of electronic equipment by continuously upgrading microprocessor technology and laminating technology to achieve the increased processing speed and lower power consumption of semiconductors.

High performance, high quality, and a stable supply must be achieved in combination, particularly for semiconductor materials like photoresists and high-purity chemicals. We make continuous efforts to improve performance and develop new applications for all key products including EUV/ArF/KrF/i-Line photoresists. At the same time, we will strive to ensure a stable supply by developing production technologies that achieve high quality in the mass production process, and taking BCP measures, among other efforts.

#### Key to high product quality—defect reduction by reducing invisible impurities

Major factors in the selection of EUV photoresists and other materials used in innovative semiconductor segments are high quality with minimized impurities, combined with high performance sensitivity and resolution. In the super clean room that started operation in the New R&D Building at the Sagami Operation Center in 2019, the entry of foreign matter from outside is minimized to handle hazardous substances with the world highest-level cleanliness, thereby enabling the identification of the source of impurities in shorter hours than before. In the cutting-edge miniaturization process, even fine impurities that cannot be observed with inspection instruments lead to compromised yields. Therefore, we implement diverse measures to detect and reduce such impurities. These measures to reduce defects are promoted while establishing logical processes through the collaboration of the Manufacturing Department, Marketing Department, and Research and Development Department in accordance with the long-term road map toward zero defects.

(see page 67, "The Cutting Edge")





The Cutting Edge



**Jung WonKyu**  
Manufacturing Team  
TOK Advanced  
Materials Co., Ltd.

**The personnel in South Korea are also continuously upgrading quality in response to ever-escalating customer requests.**

We make everyday efforts to ensure high-quality and stable production because the mass production of EUV photoresists has begun in full scale to support the cutting-edge process of semiconductor miniaturization.

While the product quality and technological difficulty required by customers are extremely high, we impartially introduce findings from both South Korea and Japan and establish a production environment under the optimal conditions through the repeated cycle for quality improvement, proceeding from risk identification to testing and then to improvement, thereby achieving customer satisfaction and high evaluation. We doubled our production capacity by abundantly introducing state-of-the-art equipment, fully preparing ourselves for the next leap.

We will continuously upgrade quality in response to ever-escalating customer requests.

**Initiatives for Material Issues: Creation of New Added Value that Contributes to Innovation and Global Environmental Conservation**

**Provision of solutions that lead to the creation of new value for customers**

We have specified the *creation of new added value that contributes to innovation* as one of our material issues. Through rigorous marketing, TOK will carefully identify and intensively and proactively address solutions that lead to the creation of new value for customers as a requirement and objective for this material issue. Many achievements were made in FY 2020/12. One of them was the development of a photoresist for sensor devices.

TOK developed and provided photoresists for CMOS image sensors used in smartphone cameras. Last year, we developed and marketed a photoresist for the ToF (Time of Flight) sensor, which applies the CMOS image sensor.

The ToF sensor measures distance based on the time between the emission of a signal and its return after reflecting off an object. The market will expand while substantially improving face recognition accuracy on smartphones and contributing to the realization of a camera that can photograph objects in low light.

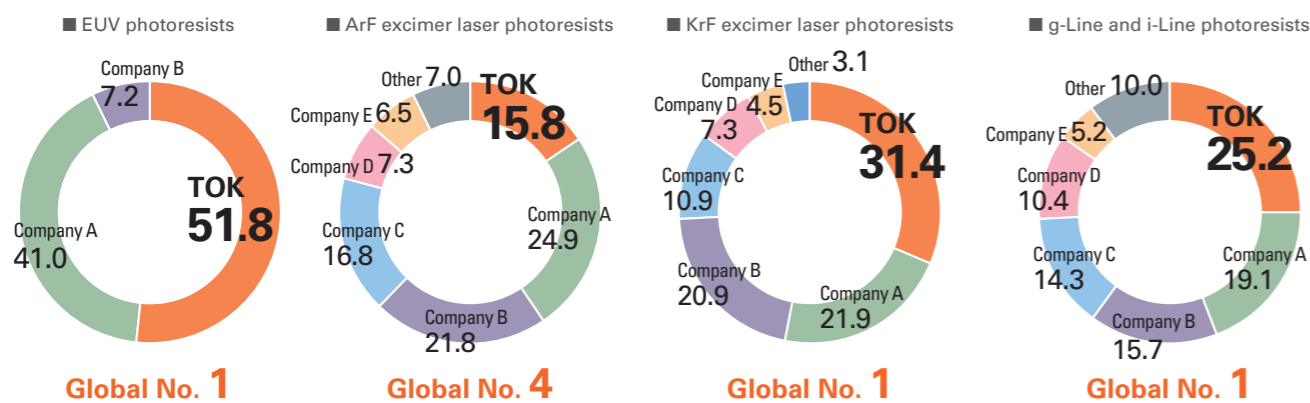
**Expected increase in businesses that combine further improvement of customer satisfaction and promotion of environmental management**

In FY 2020/12, the awareness of social sustainability rose through the aggravation of climate change risks and the impact of the COVID-19 pandemic. Among the components of product added value in B2B business, low environmental and health impact was considered as important as, or even more important than, high product performance and characteristics.

TOK promotes environmental management as one of the key initiatives for the material issue of global environmental conservation. We have ensured strict compliance with environmental regulations applicable to our products and have proactively responded to new environmental regulations. In FY 2020/12, we received requests from many customers to shift from existing products to models with reduced environmental and health impact. We developed and provided new products that satisfied required standards, and had them introduced by the customers.

We will continue to promote businesses that combine the further improvement of customer satisfaction and the promotion of environmental management, thereby contributing to the sustainable development of society.

Global market share for semiconductor photoresists (projected shipment volume share in 2020)



Source: Fuji Chimera Research Institute, "Current Status and Future Outlook of Cutting-edge/Noticeable Semiconductor-related Markets 2020"



**The Cutting Edge**

**Development of cutting-edge materials leveraging super clean room**

The high-purity processing technology is one of our core competences that contributed to the resolution of social issues in each era since the founder, Shigemasa Mukai, developed high-purity potassium hydroxide in 1934 and broadly distributed it as an essential material for batteries used in cap lights to protect the safety of coal miners. To continue upgrading this strength under the management principle "Continue efforts to enhance our technology," we started the operation of the super clean room in 2019 to handle hazardous substances with the world highest-level cleanliness, striving to reduce impurities to the ppq\* level in the cutting-edge areas of semiconductor photoresists and high-purity chemicals.

\* ppq = parts per quadrillion

**Pursuing material quality from three perspectives**

In the pursuit of the quality of cutting-edge materials using high-purity processing technology, we emphasize an approach from three perspectives: fluctuations in raw materials (e.g. impurities, metals), fluctuations in the production process (e.g. refinement, mixing, filtration, filling, containers, equipment), and fluctuations in analysis and evaluation (e.g. analysis containers, implementation methods). Among these, the super clean room plays an important role in the factor analysis and improvement of fluctuations in the production process.



New C-1 Building of the Sagami Operation Center, where R&D is promoted in cutting-edge areas centering around the super clean room to handle hazardous substances

**Company-wide promotion of the trinity of manufacturing, development, and sales as one of the most important managerial requirements**

TOK considers the further advancement of high-purity processing technology as one of its most important managerial requirements. The relevant strategies and policies are continuously discussed at the *trinity* meeting comprising the president and the directors in charge of manufacturing, development, and sales. Frontline staff also closely collaborate, rapidly sharing the development condition, customer condition, industrial condition, etc. The Production Technology Development Division functions as the core of the manufacturing process. The department aims to develop production technology required for next-generation products, logically verify the technology, and launch mass production, in addition to identifying the quality requirements for next-generation products in advance and incorporating them in the prototyping stage and leads company-wide efforts to attain these goals.

**Started to provide next-generation cutting-edge resists leveraging super clean room**

Our customer-oriented strategies have been further upgraded through the initiatives above, enabling the rapid sharing of customer condition and industrial conditions among the development, sales, and manufacturing departments in Japan and overseas. In this way, it has become possible to undertake proactive and systematic R&D activities forecast-ing customer requirements, and we have started to provide the next-generation cutting-edge resists of higher quality.



**Akiyoshi Yamazaki**  
Deputy Department Manager,  
Manufacturing Department

**Aiming at the next stage through DX and advanced collaboration with stakeholders**

A subtle difference in raw materials or production process has a substantial impact on quality in the development and manufacturing of next-generation materials for innovative semiconductor segments. We will not only analyze our internal data but also establish advanced collaboration with suppliers, customers, and other stakeholders, while aiming to realize quality forecast based on AI and statistics in the future. To this end, we will promote the analysis of process parameters that substantially affect product quality, utilizing the super clean room. At the same time, we will establish an R&D structure for next-generation production technology through a continued DX shift.

# Review of Operations

## Equipment Business

Manufacturing, sales and maintenance of semiconductor manufacturing equipment and panel manufacturing equipment



**Tsukasa Honkawa**  
Officer, Department Manager,  
Process Equipment Manufacturing Department



Shonan Operation Center



### Risks and opportunities—Equipment Business—

#### Risk

- Impact of intensifying competition with full-scale entry by major companies as competitors catching up
- Unfavorable market environment due to the escalating geopolitical risks including the U.S.-China trade friction
- Introduction of high integration processes aside from 3D packaging

#### Opportunities

- Expansion of growth opportunities in the 3D packaging market following diversification of high integration technologies
- Increase in semiconductor needs due to the accelerated global initiatives for decarbonization
- Expansion of business opportunities in the next-generation display market
- Opportunities for adoption are relatively equally obtained as the market is new
- Increase in opportunities to appeal track record in TSV equipment adoption and advantage in technology and technological improvement
- Expansion of business opportunities through the supply of high-performance equipment for coating and stripping using knowledge of materials developed in the Material Business
- Securing of earning opportunities leveraging lower break-even point thanks to the fabless production method

### Issues for Society and Customers and TOK's Solutions

#### Support for the long-term development of semiconductor technologies

Semiconductors have contributed to the realization of convenient and comfortable lifestyles around the world, as well as to the resolution of diverse social issues. Over approximately 50 years, they have achieved higher speed and larger capacity through performance upgrading based on miniaturization. Now that miniaturization is slowing, initiatives are expanding to achieve higher performance through other methods. In particular, the 3D packaging technology to vertically stack semiconductors is expected to support the long-term development of semiconductor technologies.

The TOK Group marketed the 3D packaging system called Zero Newton® in 2008 and has increased sales and acquired market share particularly among the OSAT\* manufacturers in Asia. We have also accumulated profound knowledge in this field based on the Materials & Equipment (M&E) strategy unique to TOK, which operates both the material business and the equipment business. Owing to the continued promotion of customer-oriented strategies, we are receiving increased inquiries based on lamination needs in the cutting-edge packaging area. We will therefore continue to strengthen businesses in this segment and promote the M&E strategy.

\* Outsource Assembly and Test: A business model for undertaking only production of semiconductors that specializes in the back-end processes

#### Steadily grasp the increasing needs related to decarbonization

The 3D packaging system Zero Newton® has been highly rated for its core technology to attach and separate the wafer and the carrier substrate and has been introduced by the manufacturers of high-efficiency high-performance power semiconductors that contribute to decarbonization. In particular, innovative power semiconductor wafers are thinned to below 100 um, making them very difficult to attach and separate. Moreover, there is also a need to increase yield by widening the wafer diameters. Since Zero Newton® offers superior performance for both of these objectives, we will focus on expanding sales of the product going forward.

Another flagship product for power semiconductors that has been used by customers and has maintained steady sales for many years is the plasma ashing system. We will endeavor to acquire replacement needs by proposing a lower-cost version and to increase orders by responding to the need for larger-size wafers, while emphasizing the appeal of the high resist-removal capacity unique to TOK.

#### TOK's 3D packaging system Zero Newton® and plasma ashing system



Zero Newton® bonding machine



Zero Newton® debonding machine



Plasma ashing system

#### Equipment Business Performance

(Millions of yen)

	FY 2018/12 Result	FY 2019/12 Result	FY 2020/12 Result	
			Change	%
Net sales	2,655	3,833	2,811	(1,022) (26.7%)
Segment income (loss)	(883)	(286)	(310)	(24) —
Operating margin	—	—	—	— —
Segment assets	4,245	3,612	2,015	(1,597) (44.2%)
Depreciation and amortization	63	36	32	(4) (11.1%)
R&D costs	497	509	452	(57) (11.2%)



The Cutting Edge



TOK Human Resources



**Hirohiko Tamiya**  
Section Manager,  
Marketing Section,  
Equipment Marketing Div.

### Acquiring repeat orders through global collaboration and M&E strategy

Because the 3D packaging market for semiconductors is slow to expand due to its cutting-edge nature, it is no exaggeration to say that the acquisition of repeat orders determines business profitability. We are receiving increased repeat orders for the 3D packaging system Zero Newton®. In the case of Taiwan, our local engineers carefully analyzed the initial customer assessment and identified the requirements, and the Shonan Operation Center in Japan examined how to optimize the process conditions. We acquire repeat orders by finally identifying conditions that satisfy customers, using the M&E (Materials & Equipment) strategy as our strength and making optimization proposals modifying materials and equipment conditions.

### Key Measures for the Final Year of the TOK Medium-Term Plan 2021

#### Pursue further profitability improvement as a starting point for medium- to long-term growth

We will pursue further profitability improvements in FY 2021/12 as the starting point for medium- to long-term growth by carrying on the measures that address the segment's high cost structure that results from the provision of individually customized units as original solutions for the customer.

Regarding the provision of relevant materials, consumables, and components for each unit and the proposal for the modification and overhaul of services to ensure stable earnings, we integrated the relevant subsidiaries in April 2019 to bolster our workforce in the Maintenance Division, leading to improved operating efficiency. Through these measures, we established the above operations as tasks for sales engineers, and expect to achieve a further enhancement of customer satisfaction and increased earnings in FY 2021/12. In particular, we expect further increase in the sales of relevant materials in line with the ongoing sales promotion of equipment in the Chinese market.

#### Sales promotion of 3D packaging system and plasma ashing system

As described above, the demand for the 3D packaging system Zero Newton® is increasing in line with the expansion of SoIC in the semiconductor market, and we are receiving inquiries for prospective repeat orders and the relevant negotiations will take place. As miniaturization is approaching its limit, SoIC is expected as a means to reduce the rising cost to achieve medium- to long-term market growth. We will promote the

#### As needs become increasingly diversified in the semiconductor manufacturing equipment field, TOK will continue to specialize in niche domains.



sales of the system in Asia with its high demand and in other regions, while establishing an environment for the expedited local evaluation of demonstration units. The scope of application is gradually expanding not only for SoIC but also for 2.5D and 3D semiconductors. We will endeavor to acquire repeat orders in Asia, where we fully understand market share, while pursuing orders in new markets.

As mentioned above, we will also promote the sales of the 3D packaging system and the plasma ashing system for power semiconductors related to decarbonization. At the same time, we will make continuous efforts in cutting-edge fields to develop equipment for fan-out panel level packages, as well as flexible display manufacturing equipment, to lay stepping stones for medium- to long-term growth. (see page 71, "The Cutting Edge")

#### Always considering energy-saving, reduced material consumption, and higher functionality toward the achievement of sustainability

The awareness of sustainability is being infiltrated into the B2B business through the aggravation of climate change risks and the impact of the COVID-19 pandemic. TOK will continue to promote the sales of the systems for power semiconductors (3D packaging system Zero Newton® and plasma ashing system), as part of its key initiative to *promote environmental management* for the material issue of global environmental conservation. At the same time, TOK also pursues energy saving, reduced material consumption, and higher functionality in the development of the equipment to be provided. We also develop and provide tailor-made systems in response to similar requests from individual customers.



## The Cutting Edge

### Initiatives in the cutting-edge areas lead to medium- to long-term growth

The TOK Group positions the equipment business as another key business under the most important strategy of deepening and developing the e-material field in the TOK Vision 2030. The medium- to long-term growth strategies are implemented in the equipment segment as well, focusing on the semiconductor and display segments.

#### Semiconductor field: Developed equipment for the fan-out panel level packages as a state-of-the-art area

As described earlier, we strive to increase short-term earnings from the 3D packaging system and the plasma ashing system. At the same time, we will promote the development of equipment for fan-out panel level packages (FOPLP) as state-of-the-art technology, thereby pursuing medium- to long-term growth toward 2030 and 2040.

FOPLP is technology to assemble a large number of semiconductor packages at one time using large panels. TOK developed proprietary FOPLP equipment by applying its 3D packaging system Zero Newton® and marketed the initial model in FY 2018/12. FOPLP will grow for 5G communications and autonomous vehicles that require a large number of compact and high-performance semiconductor devices. TOK will continue to promote the development of FOPLP equipment.

#### FOPLP equipment and final application concepts



#### Flexible display manufacturing equipment and final application image

Flexible display manufacturing equipment



Flexible display



#### Display field: Developed manufacturing equipment for flexible displays as the state-of-the-art area

The microprocessor technology and the high-purity processing technology as our core competences can be broadly used not only for semiconductors but also for display production. TOK also has knowledge and know-how accumulated in the era when TV and display materials/systems were its earnings driver. Therefore, TOK will continue to reinforce its business portfolio by focusing on the state-of-the-art and high-added value segments, not only in the semiconductor field but also in the display field.

#### Toward 2030: increase equipment sales under the M&E strategy

To attain TOK Vision 2030, we will specialize in the niche areas of the equipment segment and promote the M&E (Materials & Equipment) strategy to propose processes for maximizing material characteristics based on profound knowledge of semiconductor materials. Under this basic principle, we will establish service sites in the central regions with high demand in the semiconductor segment and realize the equipment while identifying and promoting customer demand. In the display segment, we will promote the local supply of flexible display manufacturing equipment, and develop customers while enhancing cost competitiveness.