AGC Group
Electronic Materials business

AGC Inc.

December 15, 2020

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Your Dreams, Our Challenge

Today's agenda

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- Electronic Materials General Division within the AGC Group
- Major products and business locations
- Business direction and strengths
- Semiconductor-related materials
- Optoelectronics materials
- Future development of electronic materials operations

Today's agenda

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Electronic Materials General Division within the AGC Group (1)

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AGC Group

1,518 billion yen

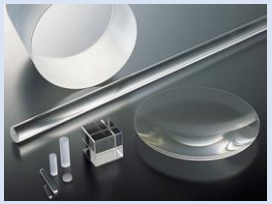
- Glass segment
  742.9 billion yen
- Electronics segment
  276.7 billion yen
- Chemicals segment
  475.8 billion yen
- Others and eliminations
  22.6 billion yen

(Net sales for the year ended December 2019)

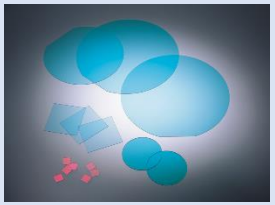
Display segment 174.7 billion yen

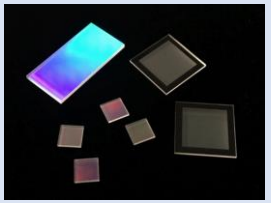
Electronic materials segment 90.5 billion yen

- Semiconductor-related materials




- Optoelectronics materials






- Lighting products
- Laboratory equipment, etc.

- Printed circuit board materials

Electronic Materials General Division within the AGC Group (2)

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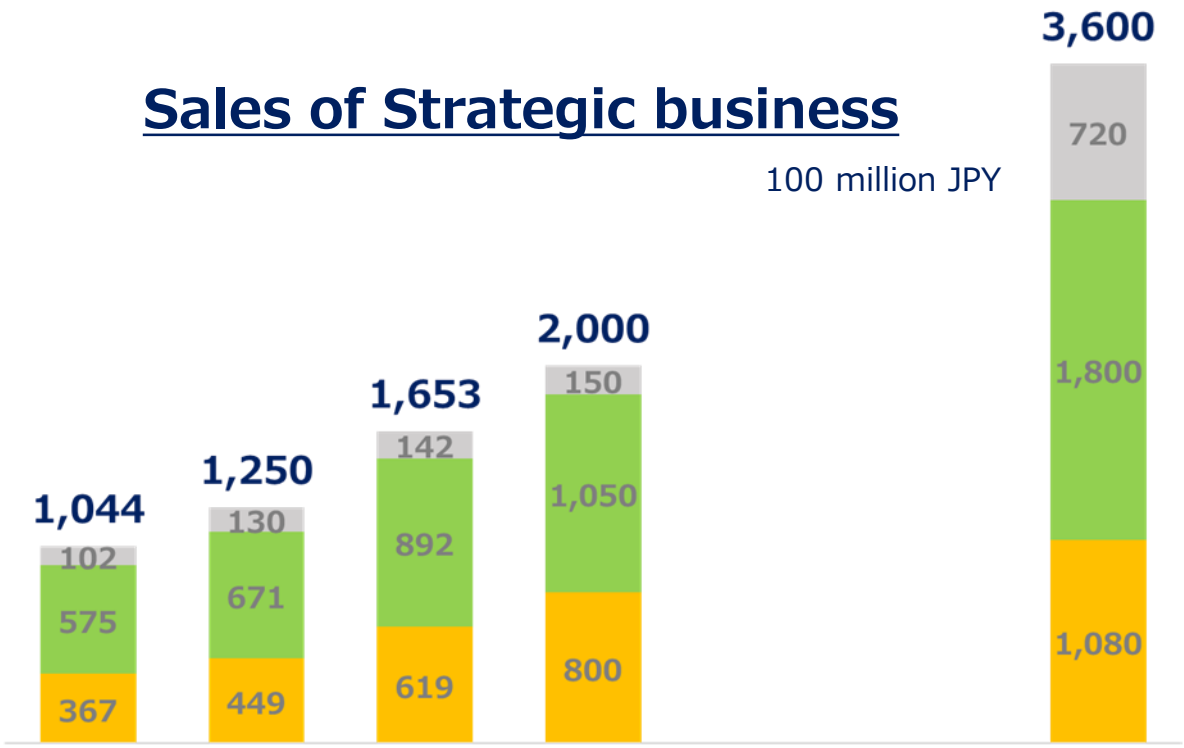
AGC's positions Mobility, Electronics, and Life Science as its strategic businesses, and the Electronic Materials General Division is categorized under Electronics.

* There are some businesses that are not included in Electronics.

Sales of Strategic business

100 million JPY



Major products & businesses

Mobility
- Cover glass for car-mounted displays
- New materials for mobility, including 5G communications

Electronics
- Semiconductor-related products
- Optoelectronics materials
- Next-generation high-speed communication related products
- Fluorinated products for electronics

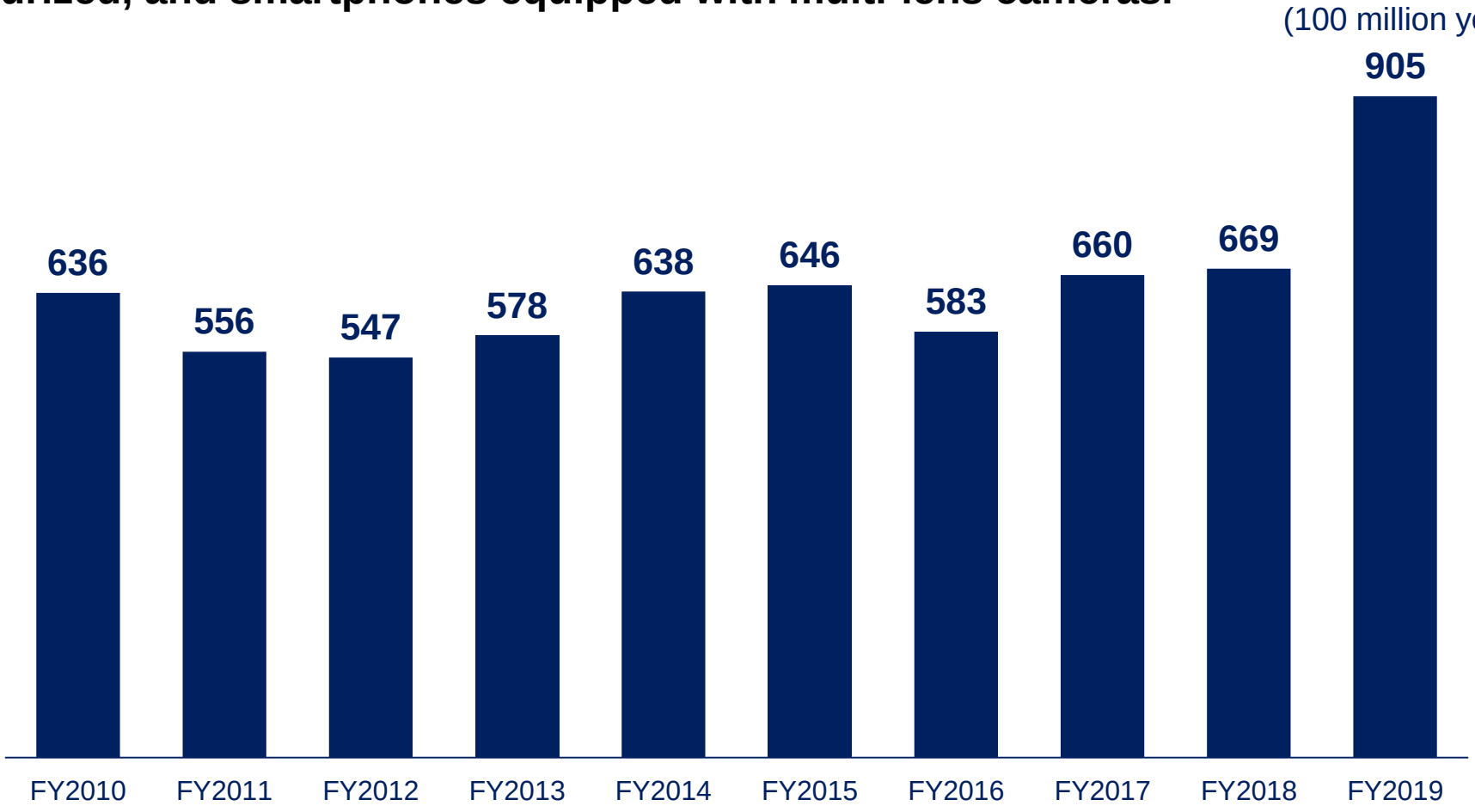
Life Science
- Synthetic pharmaceutical and agrochemical
- Bio Pharmaceuticals

	FY2017	FY2018	FY2019	FY2020e		FY2025e
OP (strategic business)	120	210	268	320		900
Contribution ratio	10%	17%	26%	58%		40%

(100m JPY)

Sales in Electronic Materials segment

In recent years, the sales increased by providing materials for growing markets, including the semiconductor market in which chip circuit patterns have been miniaturized, and smartphones equipped with multi-lens cameras.



Note: Sales in 2019 are calculated by subtracting the newly consolidated amount of the copper-clad laminate (CCL) business from sales in the electronic materials business.

ROCE of Electronic Materials segment

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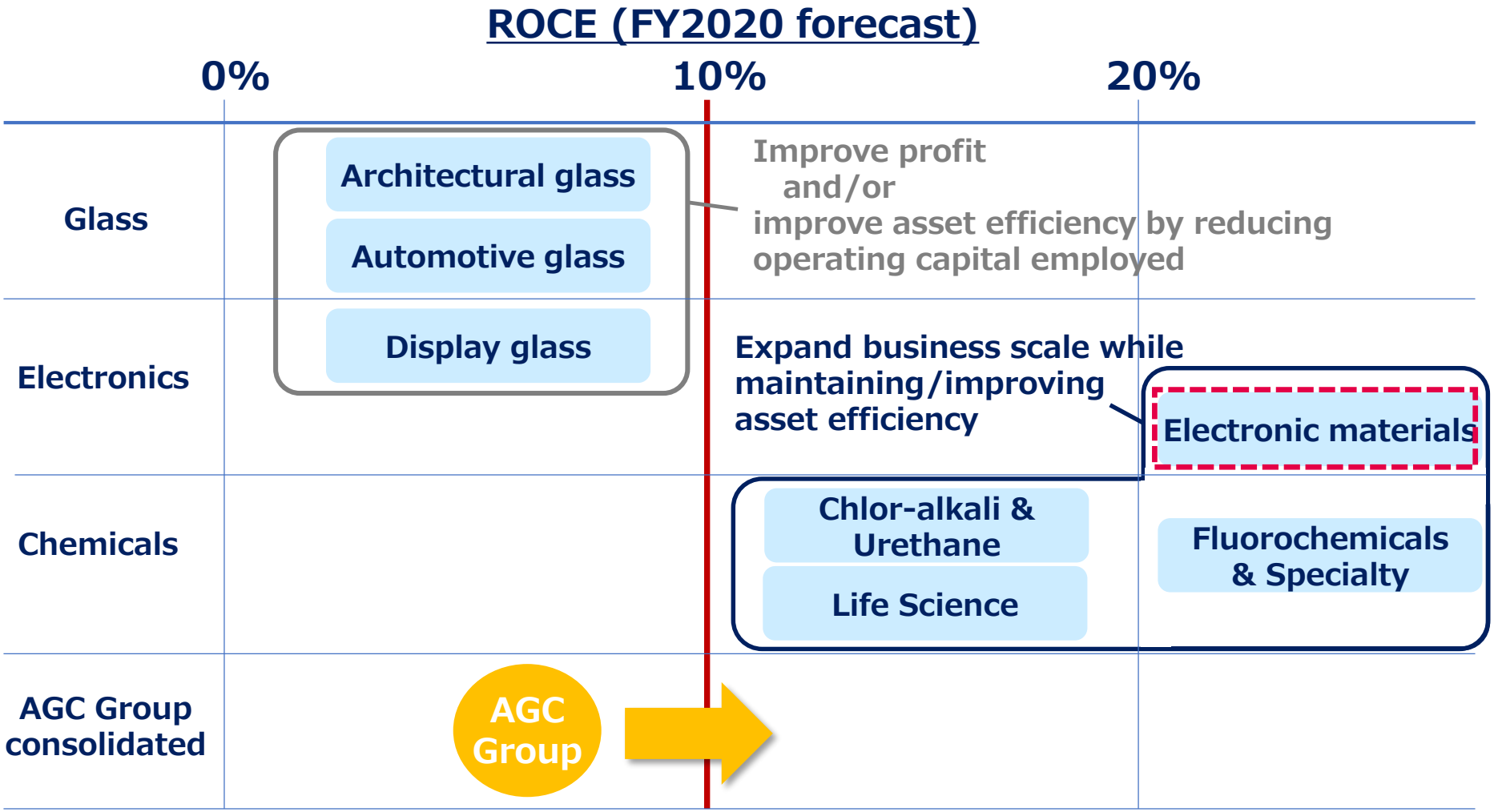
* Excerpt from the "Progress of Medium-Term Management Plan" material announced on February 5, 2020



ROCE : (OP forecast for FY2020)/(FY2020 year end operating capital employed(Trade receivables+Inventory −Trade payables +Fixed assets)).
Corporate expense is not allocated to OP forecast of each sub-segment.

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Products offered by the Electronic Materials General Division

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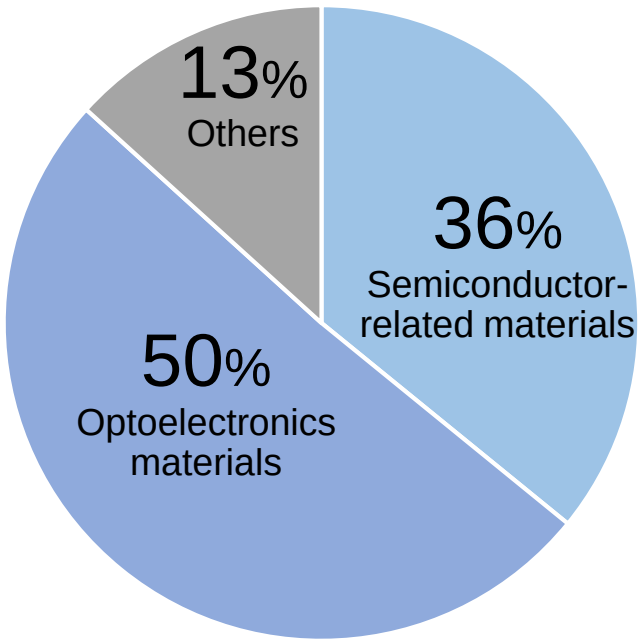
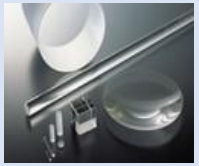
The Electronic Materials General Division consists of various products, and the sales scale of each product varies from large to small.



Net sales ratio in 2019

Semiconductor-related materials


Synthetic quartz glass


SiC heat treatment jigs


CMP slurry


EUV blanks

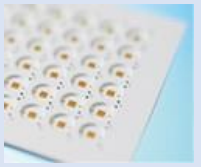

Frit paste

Optoelectronics materials


IR-cut filters


DOE (diffractive optical element) Diffusers


High refractive glass


Glass ceramic substrates


Glass mold lenses

Others


Lighting materials


Laboratory glassware


Heat-resistant glass tableware


Cell cultivation containers


Polycarbonate film

History of the Electronic Materials General Division

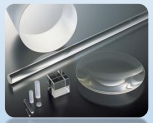
AGC's history in electronic materials spans over 30 years

January 2005
The Electronics & Energy General Division is established
(Predecessor of Electronic Materials General Division)

1980s | 1990s | 2000s | 2010s

Semiconductor-related materials

1985
Synthetic quart
Start of production



1986
SiC heat treatment jigs
Start of production

1992
Frit paste
Production begins in Koriyama

2003
CMP slurry
Start of production

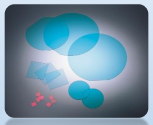
2003
EUV blanks...Joins semiconductor consortium

2017
EUV blanks
Start of production

2020
EUV blanks
Facility enhancement

Optoelectronics products

1992
IR-cut filters
Start of production

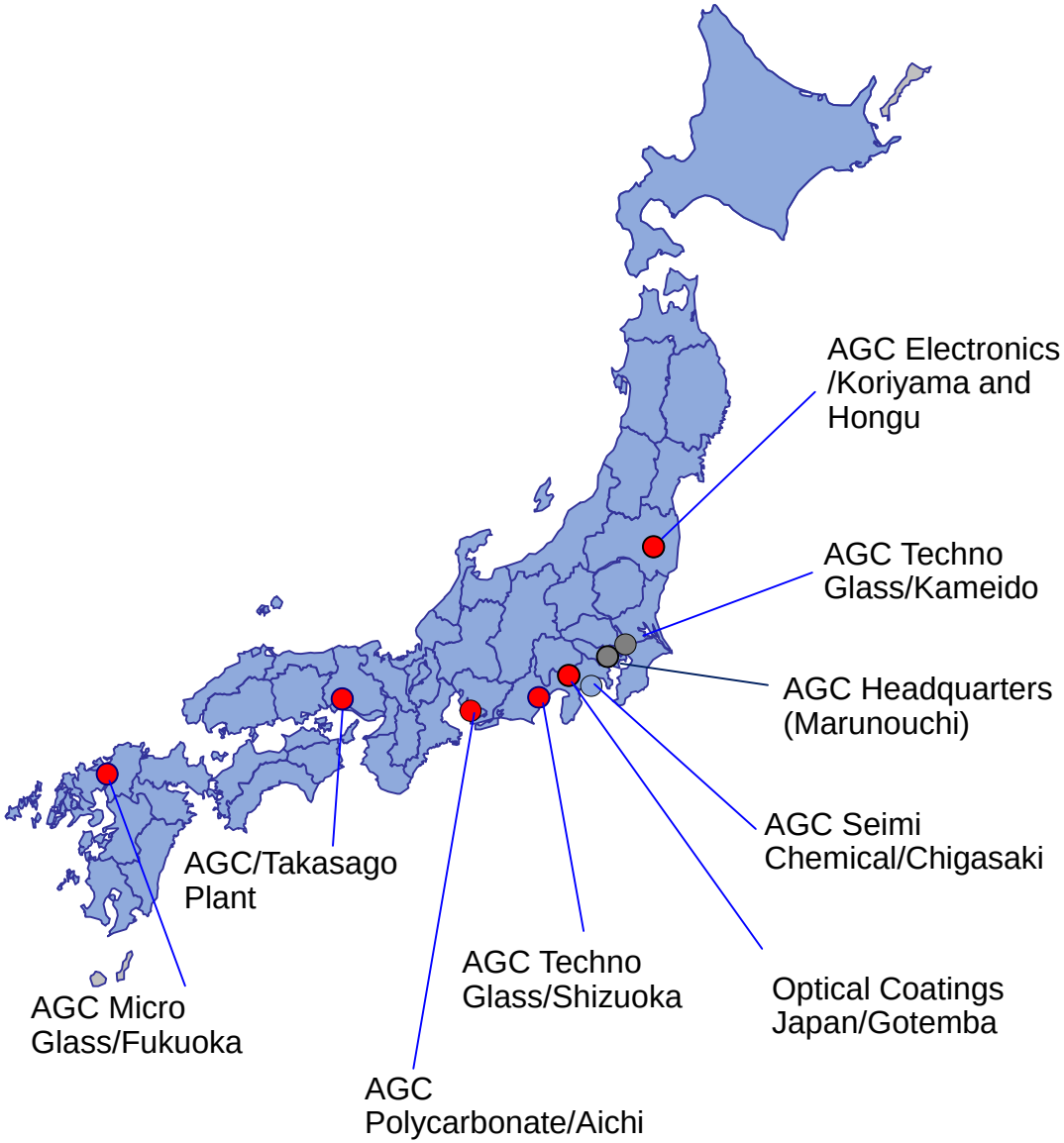


2006
Acquires Matsushima Optical Component, an aspherical glass lens manufacturer

2010
Glass ceramic substrates
Start of sales

2019
Glass for AR/MR
Start of sales

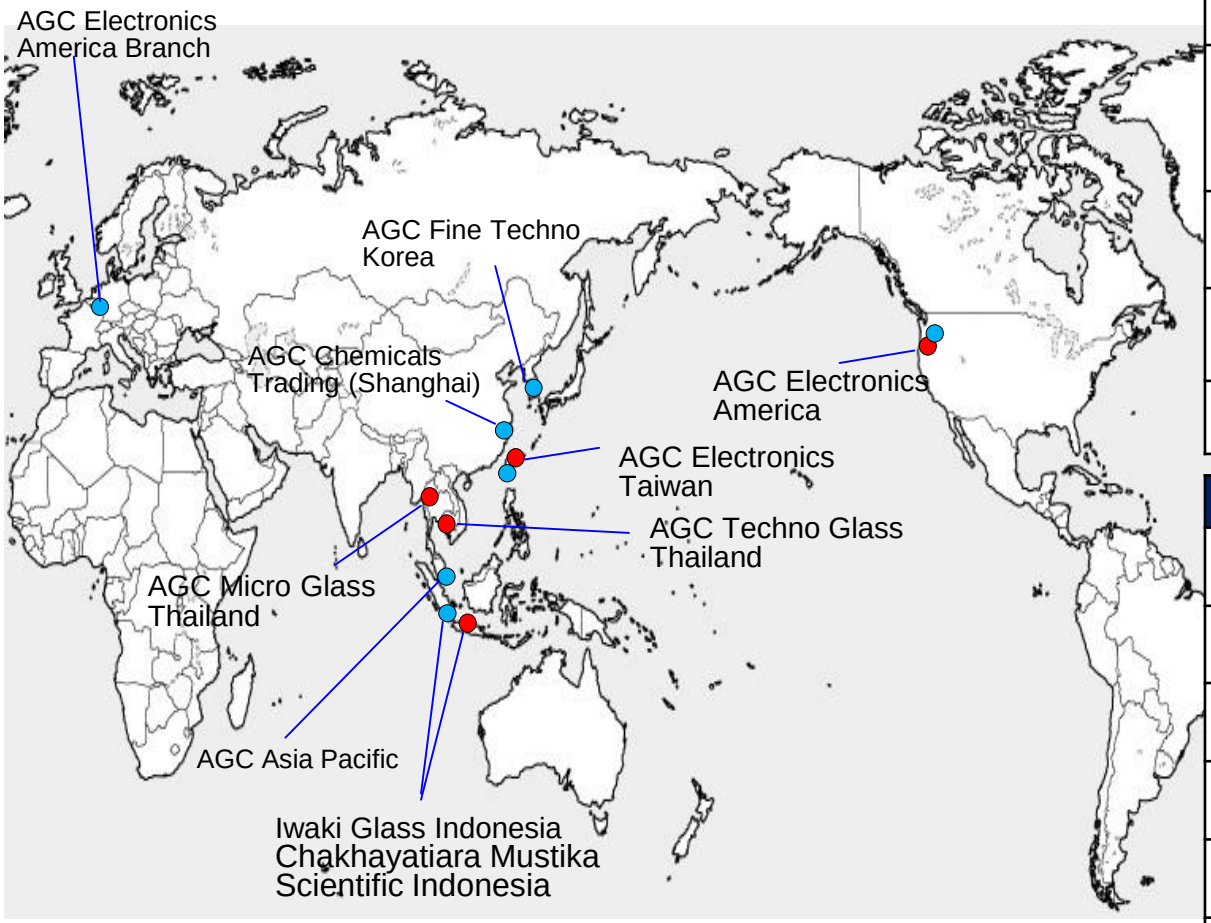
Electronic Materials General Division's bases in Japan



Manufacturing bases ●	Products
[Hyogo(Takasago)] Takasago Plant, AGC Kansai Plant	SiC heat treatment jigs
[Fukushima(Koriyama and Motomiya)] AGC Electronics	Synthetic quartz glass, EUV blanks, glass frit pastes, IR-cut filters, etc.
[Kanagawa(Chigasaki)] AGC Seimi Chemical Chigasaki Plant	CMP slurry
[Shizuoka(Haibaragun)] AGC Techno Glass Shizuoka Plant	IR-cut filters, cell cultivation containers, etc.
[Shizuoka(Gotemba)] Optical Coatings Japan	Optical thin film deposition
[Aichi(Takeyoto)] AGC Polycarbonate	Polycarbonate
[Fukuoka(Fukuoka)] AGC Micro Glass	Glass mold lenses

Sales bases ○
[Tokyo] AGC Headquarters
[Tokyo] AGC Techno Glass Kameido Office

Electronic Materials General Division Overseas Bases



Manufacturing bases (5 locations) ●	Products
[Europe and US] AGC Electronics America	SiC heat treatment jigs CMP slurry
[Thailand] AGC Techno Glass Thailand	Lighting materials, aspherical lenses, laboratory glassware, heat-resistant glassware
[Thailand] AGC Micro Glass (Thailand) Co., Ltd.	IR cut filters Glass mold lenses
[Indonesia] Iwaki Glass Indonesia	Laboratory glassware
[Taiwan] AGC Electronics Taiwan	Glass ceramic substrates

Sales and marketing bases (6 locations) ●
[Europe and US AGC Electronics America
[Singapore] AGC Asia Pacific
[Indonesia] Chakhayatiara Mustika Scientific Indonesia
[China] Asahi Glass Chemicals Trading (Shanghai) Co., Ltd.
[Taiwan] AGC Electronics Taiwan
[Korea] AGC Fine Techno Korea

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Direction of the Electronic Materials General Division

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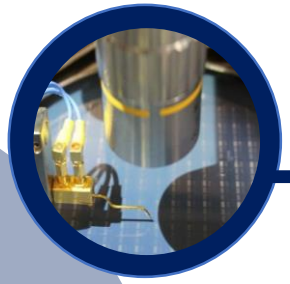
Aiming for sustainable growth through two businesses



Semiconductor-related materials

- The semiconductor market, centered on high-performance semiconductors, is expected to grow steadily over the long term.
- Based on the semiconductor development roadmap, we aim to steadily expand our business centered on EUV blanks and high-performance slurries.

Optoelectronics materials

- Our current mainstay, IR-cut filters for cameras, will continue to grow as the number of smartphones equipped with cameras increases.
- We are developing a wide range of optical components for new devices that are expected to grow in the future, such as AR/VR, car-mounted applications, and 3D sensing.
- Launching innovative new products for new applications

Strengths of the Electronic Materials General Division

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"Organic materials + inorganic materials" cultivated in glass, chemicals, and ceramics

"Materials technology x processing technology x design/evaluation/analysis technology"

Materials technology

Examples:
- **Glass (Composition/Melting/Molding)**
- **Polymers**
- **Coloring materials (dyes/pigments)**
- **Adhesives**
- **Dry coating materials**

Extracting technology Enhancing

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Processing technology

Examples:
- **Glass processing**
- **Micro-machining**
- **Glass mold forming**
- **Wafer process**
- **Film process**
- **Imprint process**

Extracting technology Enhancing

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Design/evaluation/ analysis technology

Examples:
- **Optical design**
- **Mechanical and thermal design**
- **Chemical molecular structure design**
- **Simulation technology**

Extracting technology Enhancing

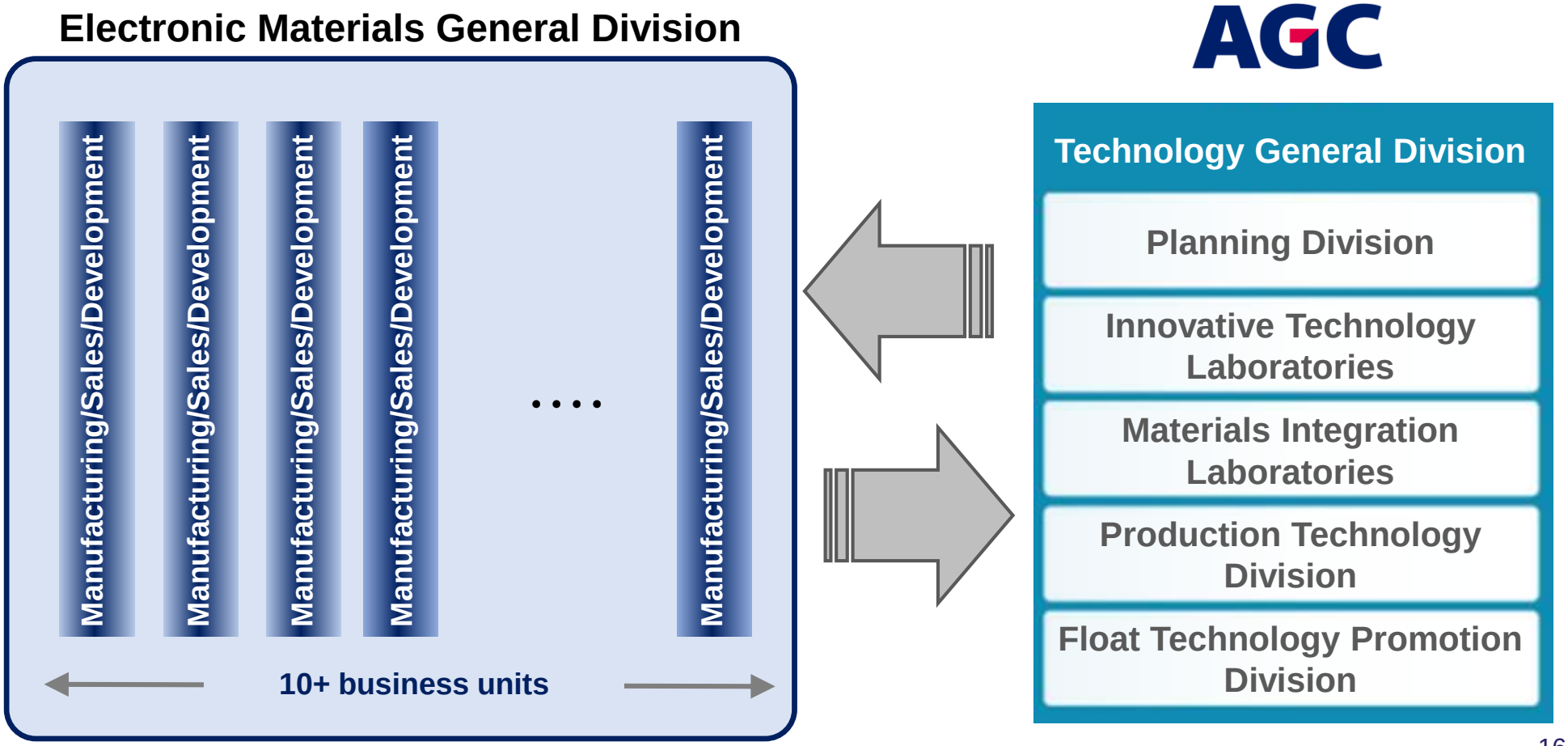
Providing AGC' unique solutions by combining materials, processing, and design technologies

Contributing to the advancement of the semiconductor and optoelectronics industries

Operating structure of the Electronic Materials General Division

Introducing “small business unit system” integrating manufacturing and sales to respond to rapidly changing industries

Promoting the creation of new products and improvement of production technology by utilizing common fundamental technologies of the AGC Group



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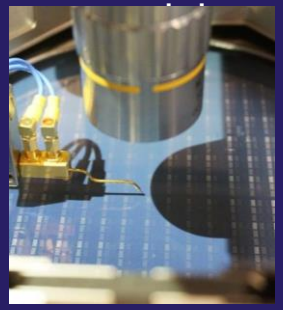
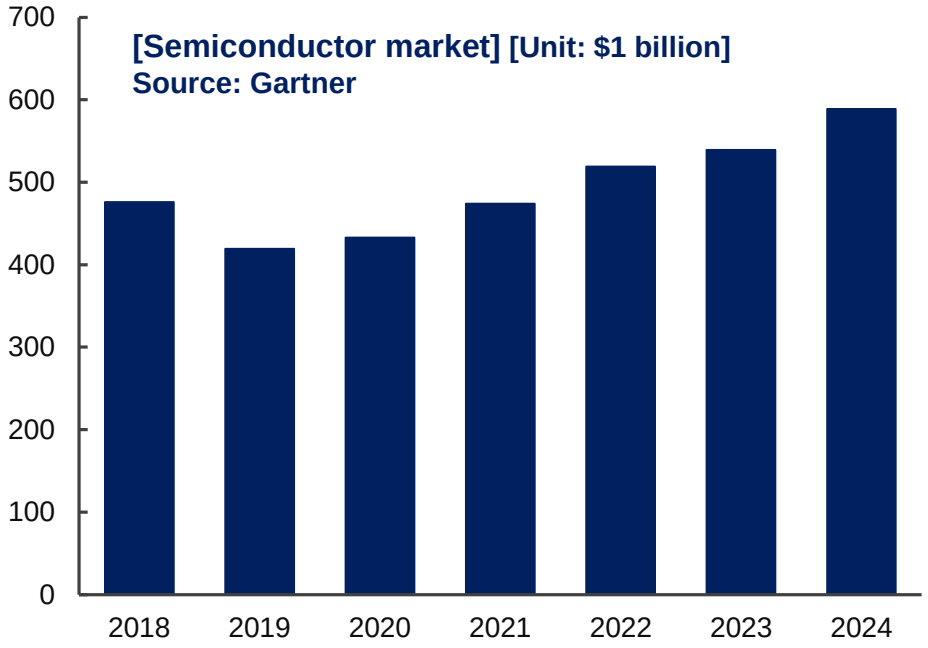
Semiconductor process materials and market overview

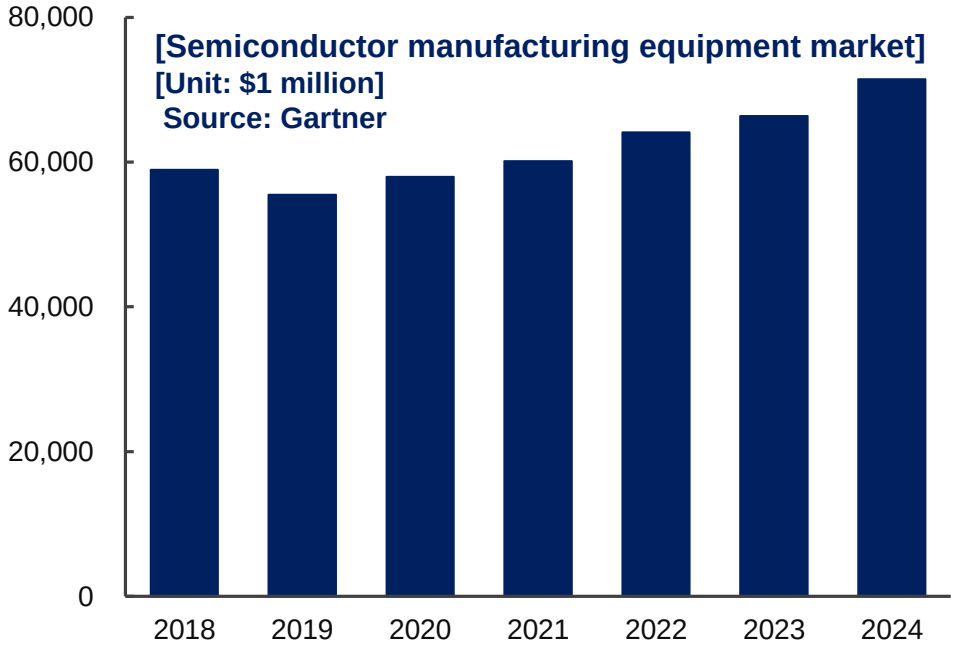
Semiconductor process



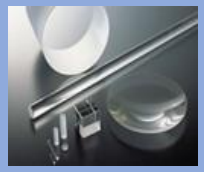
Market overview

- In the semiconductor market, along with remote work becoming a way of life and the spread of AI, utilization of semiconductors will advance. The market is expected to continue growing with the trends of "performance enhancement", “multifunctions” and "downsizing" after 2021.
- With the growth and diversification of the semiconductor market, the semiconductor manufacturing equipment market is expected to continue to grow.





Semiconductor process materials and market overview



Synthetic quartz: High purity, quality, and performance glass for semiconductor processes
- Manufacture of fine glass, fine chemical and fine ceramics based on AGC's years of research and development
- Suitable for optical components of semiconductor processes such as lithography equipment, and also used in various optical components

SiC heat treatment jigs: High purity, high strength, low thermal expansion ceramics
- Has been sold for over 30 years of experience as a material for semiconductor manufacturing equipment used mainly at high temperatures
- Due to its excellent heat resistance, it is used in the frame of EUV lithography equipment and SiC power device applications.

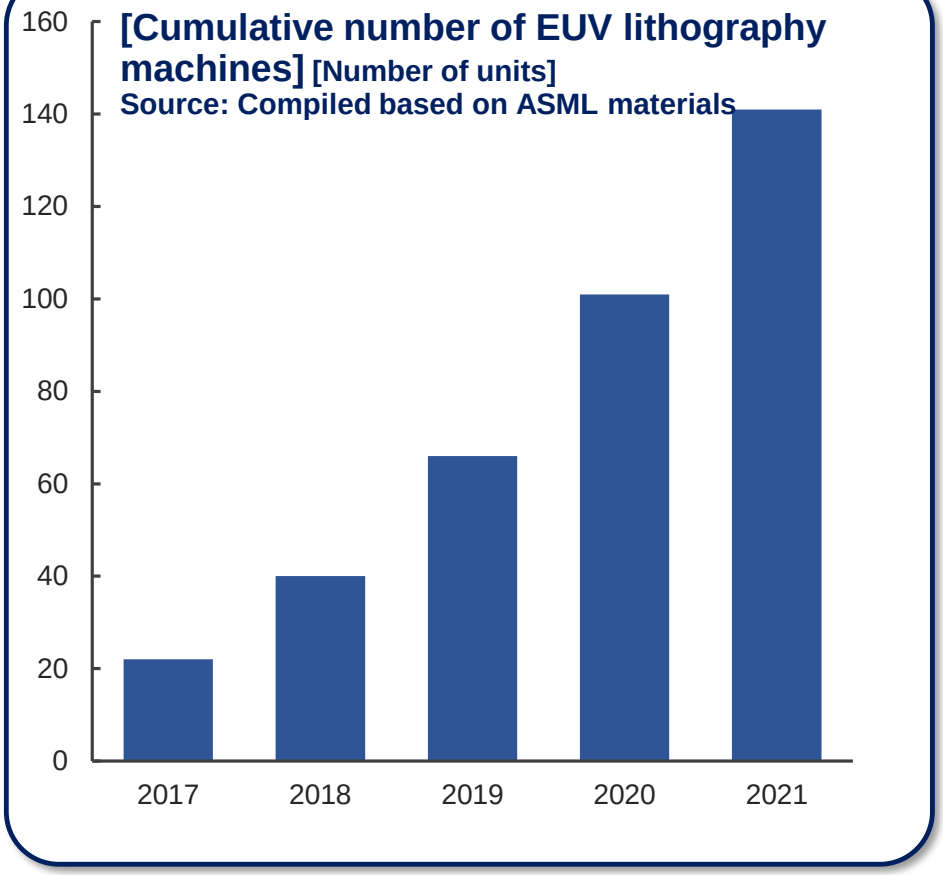
CMP slurry: High-quality slurry that meets customer design rules and processes
- Supplying slurry that achieves a highly flat multilayer structure optimized for various applications such as oxide films and wiring materials.
- It is also being used in memory applications, mainly for leading-edge logic.

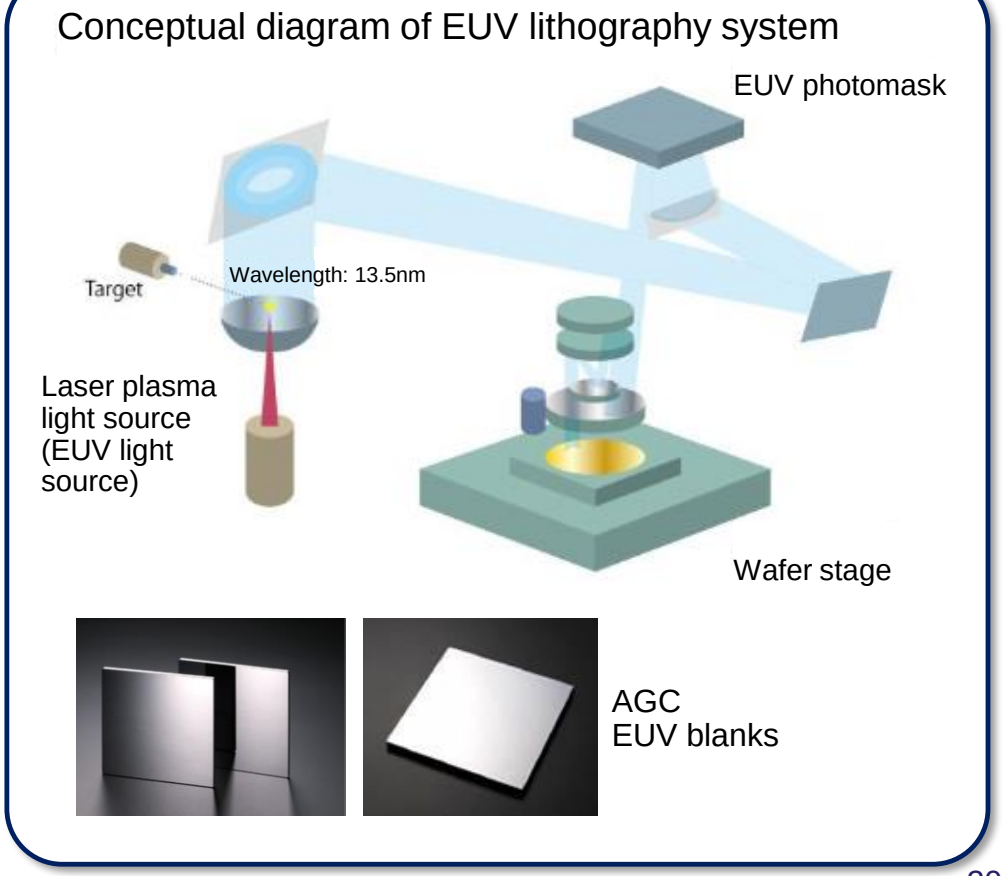
EUV blanks: High quality photomask blanks for advanced lithography
- Supplied through integrated production from glass materials to film formation for cutting-edge EUV lithography processes
- Achieving ultra-low defects, ultra-flatness, and highly functional films, we are supplying them to the most advanced lines of semiconductors

Frit paste: Glass material such as that for insulating and hermetic sealing
- Products are available in a variety of forms, including powders, pastes, and compacts. These are used in many electronics fields.
- Utilizing our compositional design and analytical capabilities, we have expanded the application fields for frit paste as a highly functional electronic material.

Semiconductor process materials / major products / EUV blanks

- **EUV lithography equipment has spread rapidly due to miniaturization of semiconductor chip circuit patterns.**
- **Demand for EUV blanks also grew significantly in proportion to the growth in the number of EUV lithography units shipped.**
- **AGC joined a development consortium in 2003 and entered the industry when it was first established.**





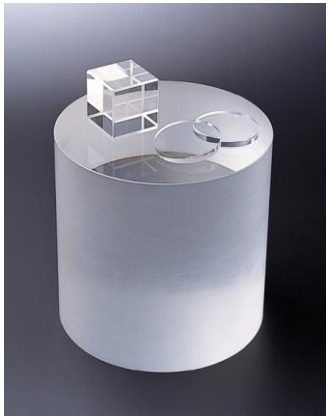
Semiconductor process materials / major products / EUV blanks

The only blanks maker in the world that produces everything from glass materials to polishing and film formation.

We have been a member of the Semiconductor Industry Consortium since 2003 and have developed technologies to achieve strict quality standards.

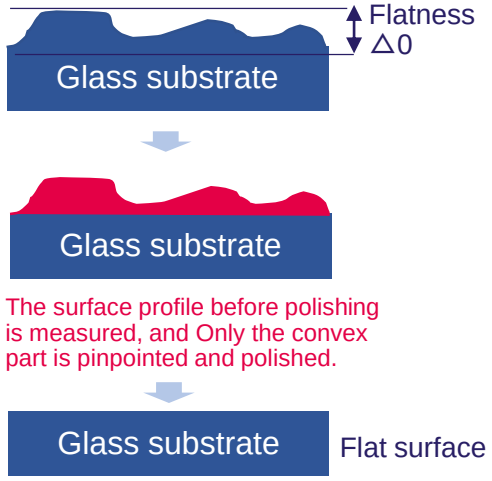
Low expansion glass substrate

We started development of synthetic quartz production technology in 1982, and produced high-purity substrates using technology and knowledge accumulated over many years.



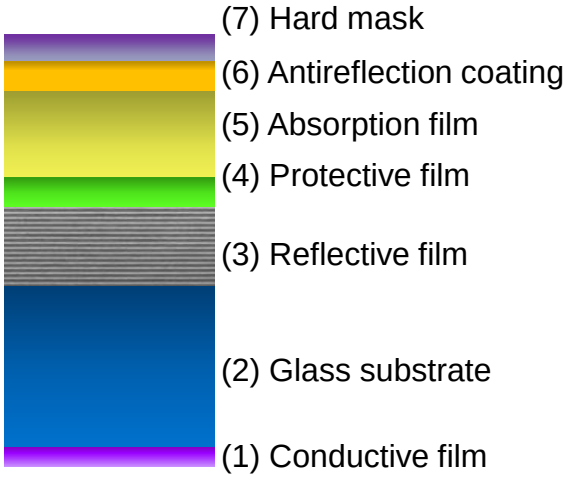
Polishing

A special polishing method has been developed to meet the specific quality requirements (substrate flatness) of EUV blanks.
Achieves ultra-high planarization through integrated production of substrates and polishing



Film deposition

We will satisfy customer requirements with optimum film design capability for high definition and film formation technology that reduces defects.



Semiconductor process materials / major products / EUV blanks

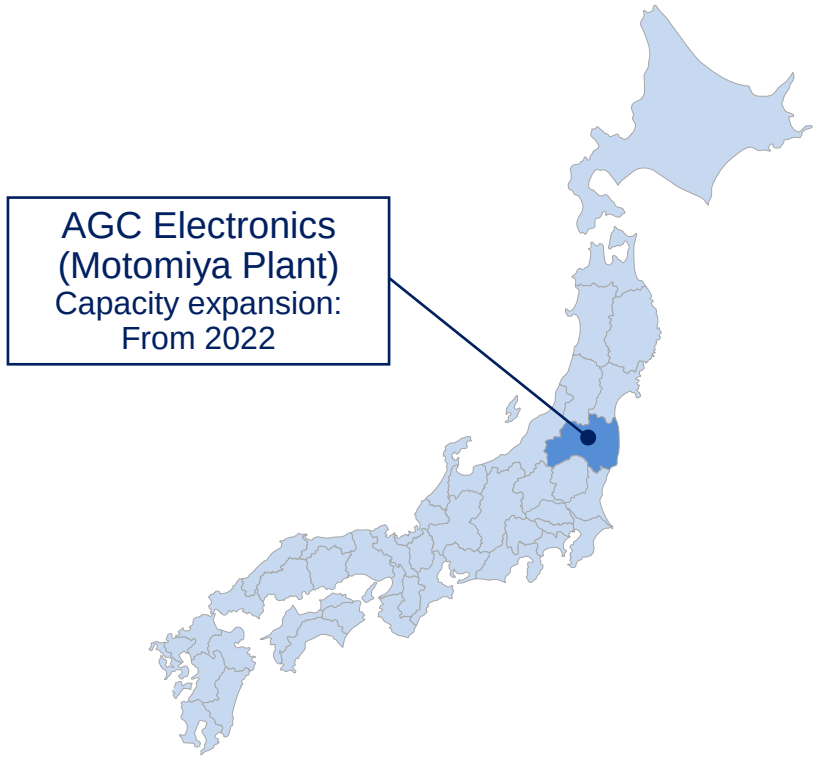
Timely investment in line with the expansion of the EUV lithography market to meet rapidly growing demand for mask blanks.

~ July 27, 2020 news release ~

To respond to further growth in the market, AGC has decided to drastically expand its supply system at its Group company, AGC Electronics (Headquarters: Koriyama, Fukushima Pref.).

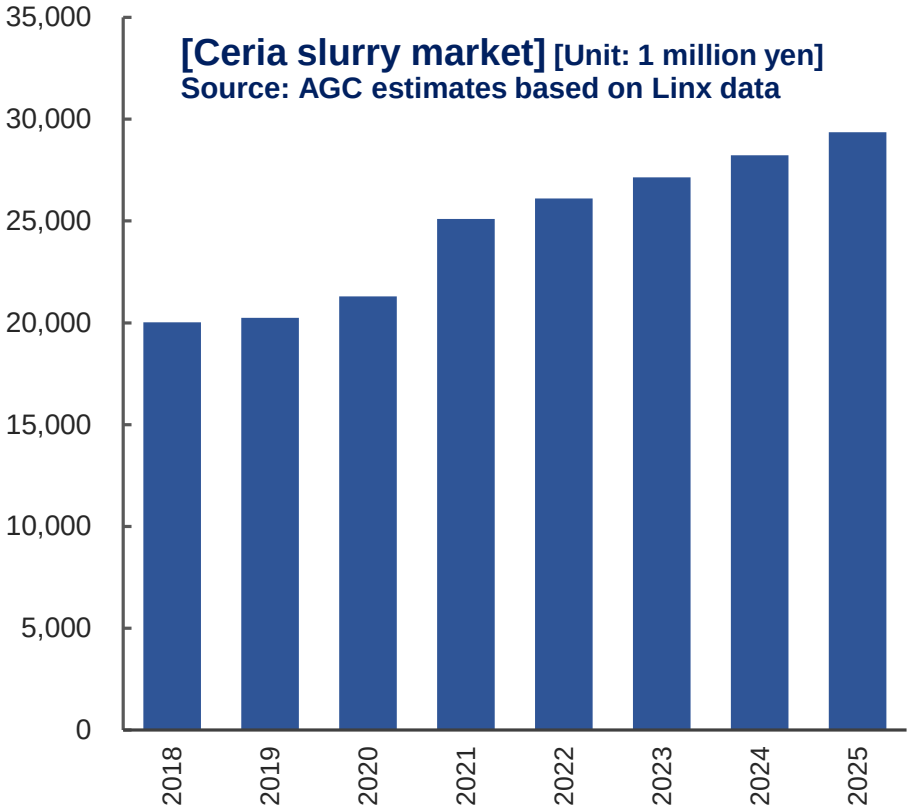
Construction including building expansion will start in October 2020 and operations are scheduled to start in 2022.

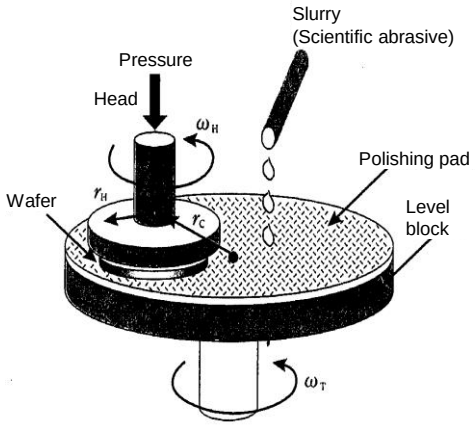
AGC Electronics production facility after expansion (conceptual drawing)

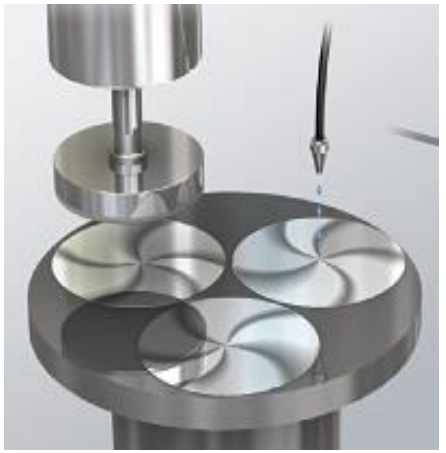


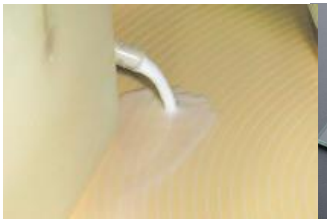
Semiconductor process materials / major products / CMP slurry

- Sales of ceria slurry are expected to increase to 29 billion in 2025 from 20 billion yen in 2019.
- One factor is that the number of layers to which ceria is applied increases, especially in the front-end process for logic.
- The market size may further expand if it is adopted for laminating of logic in the future.









Semiconductor process materials / major products / CMP slurry

AGC is only brand in the world that produces everything from abrasive process up to slurry production.

We provide “high quality slurry” + “solutions” for customer design rules and processes.

Slurry design (Abrasive grain, composition) → Abrasive production → CMP slurry → Customer support

Original abrasive grains with controlled physical properties

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Composition design focusing on additives to control polishing properties

=

CMP slurry

Achieving stable quality through manufacturing process management and control

- ✓ Achievements in applying cutting-edge processes
- ✓ Proposing solutions including polishing process
- ✓ Swift technical support
- ✓ Continuous proposal of improvements

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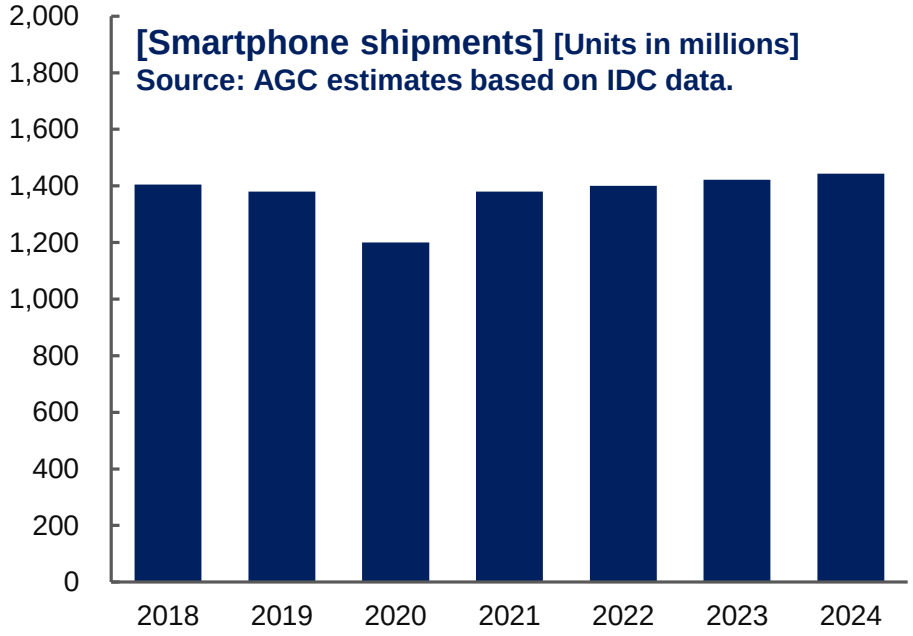
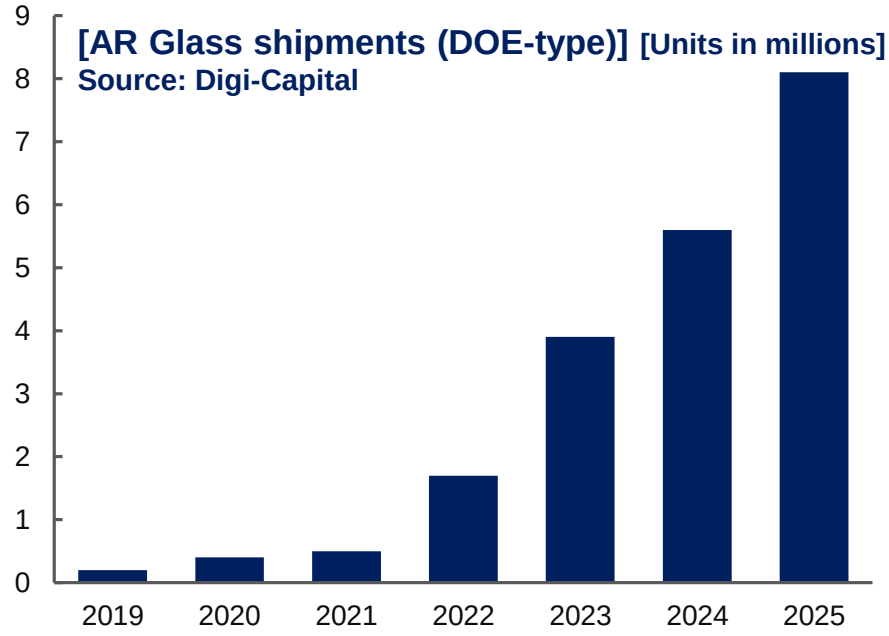
Optoelectronics materials and market overview

Optoelectronics materials

Market overview

- Although the growth rate of smartphones in expected to decline in 2020 due to the impact of COVID-19, we expect stable demand after 2021, driven by the spread of 5G and replacement of phones as a daily necessity.
- The AR market has been slow to take off, but the AR glass market is expected to grow rapidly with the expansion of 5G networks. We also look forward to the emergence of new devices those integrating smartphone functions.

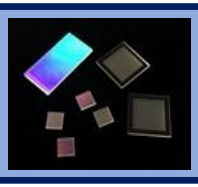




Optoelectronics materials / business development

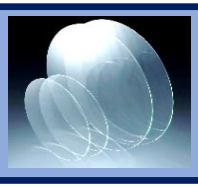
IR-cut filters: Glass filters achieving very challenging spectroscopic characteristics

- We are leading the industry in high-performance glass filters to match the sensitivity of CCD and CMOS image sensors used in digital cameras, such as cell phone cameras, surveillance cameras, and car-mounted cameras, with the sensitivity of the human eye.



DOE/Diffusers: Glass micro-optical elements that achieve high performance, reliability, and light resistance

- Diffractive optical elements (DOE) and glass diffusers used for 3D sensing, LiDAR, facial recognition, etc.
- We propose proprietary optical design, microfabrication, and mass production technologies developed from our experience in optical pickup and communication devices.



High refractive glass: Glass substrates used in next-generation displays

- We are proposing a wide variety of new glass substrates with high refractive rates and transmittance for use in Augmented Reality (AR) and Mixed Reality (MR) glass as well as smartphone glass.

Glass ceramic substrates: Contributing to improved brightness and output of LED and semiconductor lasers

- With excellent heat dissipation and reliability against discoloration and degradation, our products contribute to higher output and improved durability of LED products with a wide range of wavelengths.
- In the visible light region, the reflectivity is about 20% higher than that of alumina substrates, which contributes to enhanced luminance.

Glass mold lenses: Aspherical glass lenses that improve the performance of optical equipment.

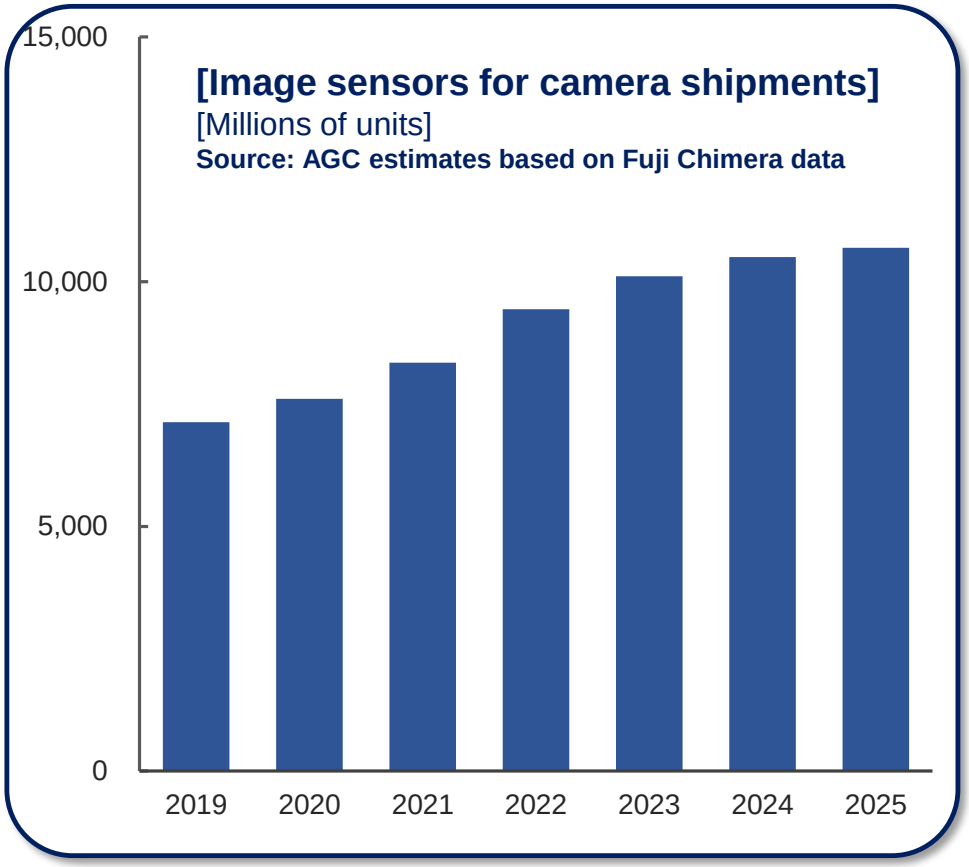
- Aspherical lenses made using glass mold precision molding technology greatly improve the performance of optical equipment.
- An aspherical glass lens made of chalcogenide glass with excellent infrared transmittance is a proposal for use in night vision cameras.

Optical membranes: A thin optical membrane product that can handle a wide wavelength range from UV to IR.

- We supply a wide range of optical thin film products that can fully demonstrate their functions and performance in fields such as healthcare, measurement, imaging, lithography, industrial equipment, space and astronomy, biotechnology, consumer electronics, and lighting.

Optoelectronics materials: IR-cut filters

- **Smartphone growth will slow, but the number of cameras installed will continue to grow as the number of lenses increases.**
- **The role of IR-cut filters will grow even more significant as image sensors become larger and demand for video recording increases.**
- **Larger filters have increased sales volume on an area basis more than on a unit basis.**



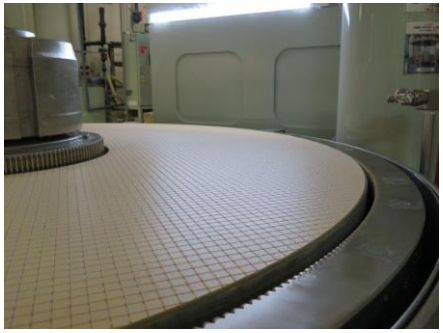
Semiconductor process materials / major products / IR-cut filters

A fully integrated filter manufacturer that handles all processes from glass melting to molding and processing

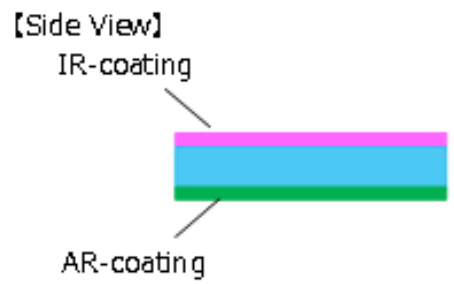
The combination of glass and film formation and optical design technology achieves challenging spectral characteristics and contributes to higher image quality in cameras.

Melting → Polishing → Film deposition → Cutting

Sharp absorption in the infrared region is achieved by using fluorophosphate glass and introducing Cu++ ions.



Multiple layers of optical thin films with different refractive rates are deposited to realize various spectroscopic characteristics.



AGC's unique cutting method enables high-quality cutting surfaces.

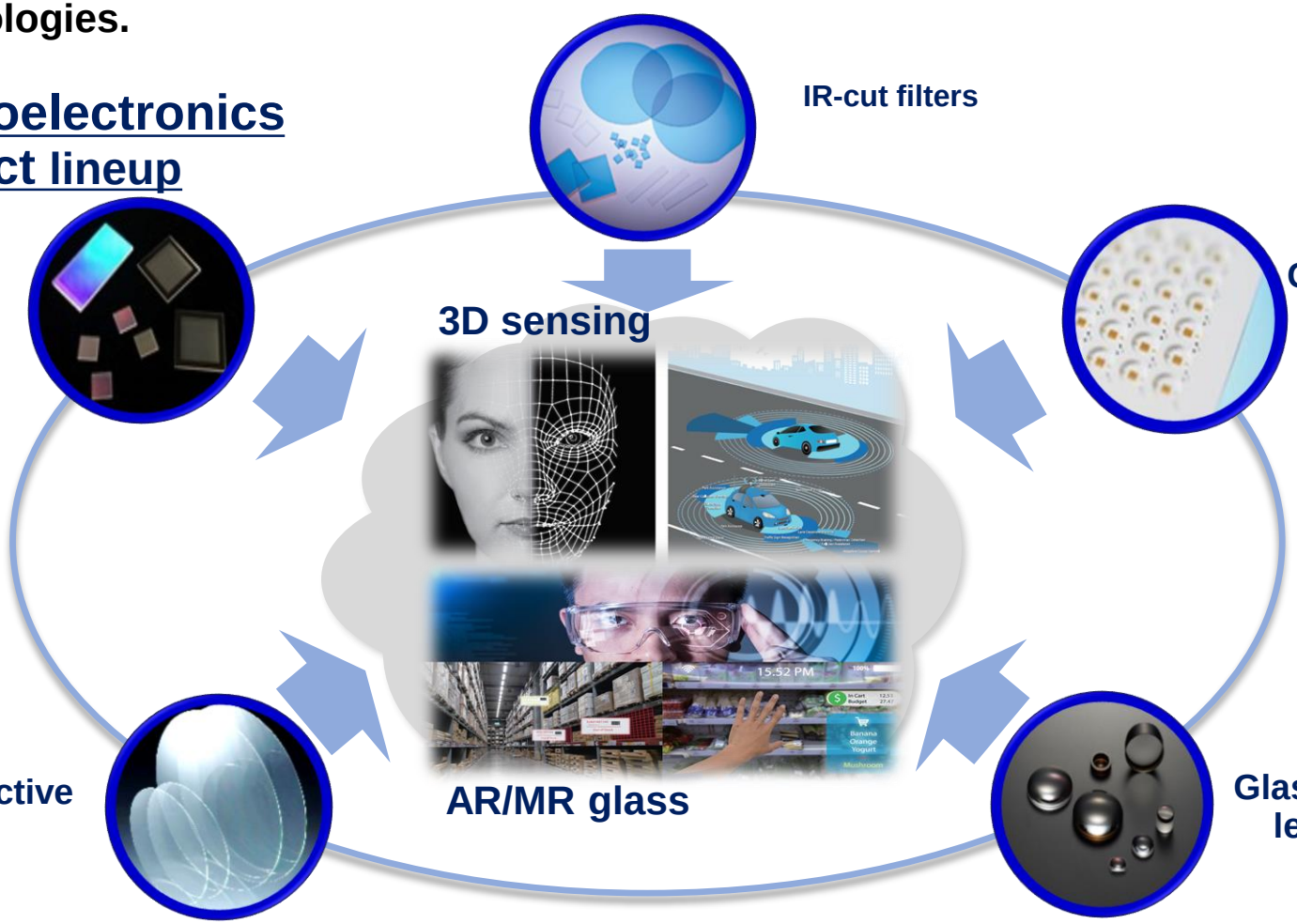
Optoelectronics materials / major products / New fields and products

AGC
Your Dreams, Our Challenge

Many optical materials are installed in sensing and AR/MR glass

- We are expanding into our next markets with optoelectronic products cultivated through our experience with cameras.
- We aim to launch innovative new products for new applications with a wide range of optical-related technologies.

AGC's optoelectronics product lineup



Today's agenda

- Electronic Materials General Division within the AGC Group
- Major products and business locations
- Business direction and strengths
- Semiconductor-related materials
- Optoelectronics materials
- **Future development of electronic materials operations**

Our vision for electronic materials operations

In addition to our existing semiconductor-related materials and optoelectronics materials, we will aim for sustainable growth through new products as a solid earnings base.

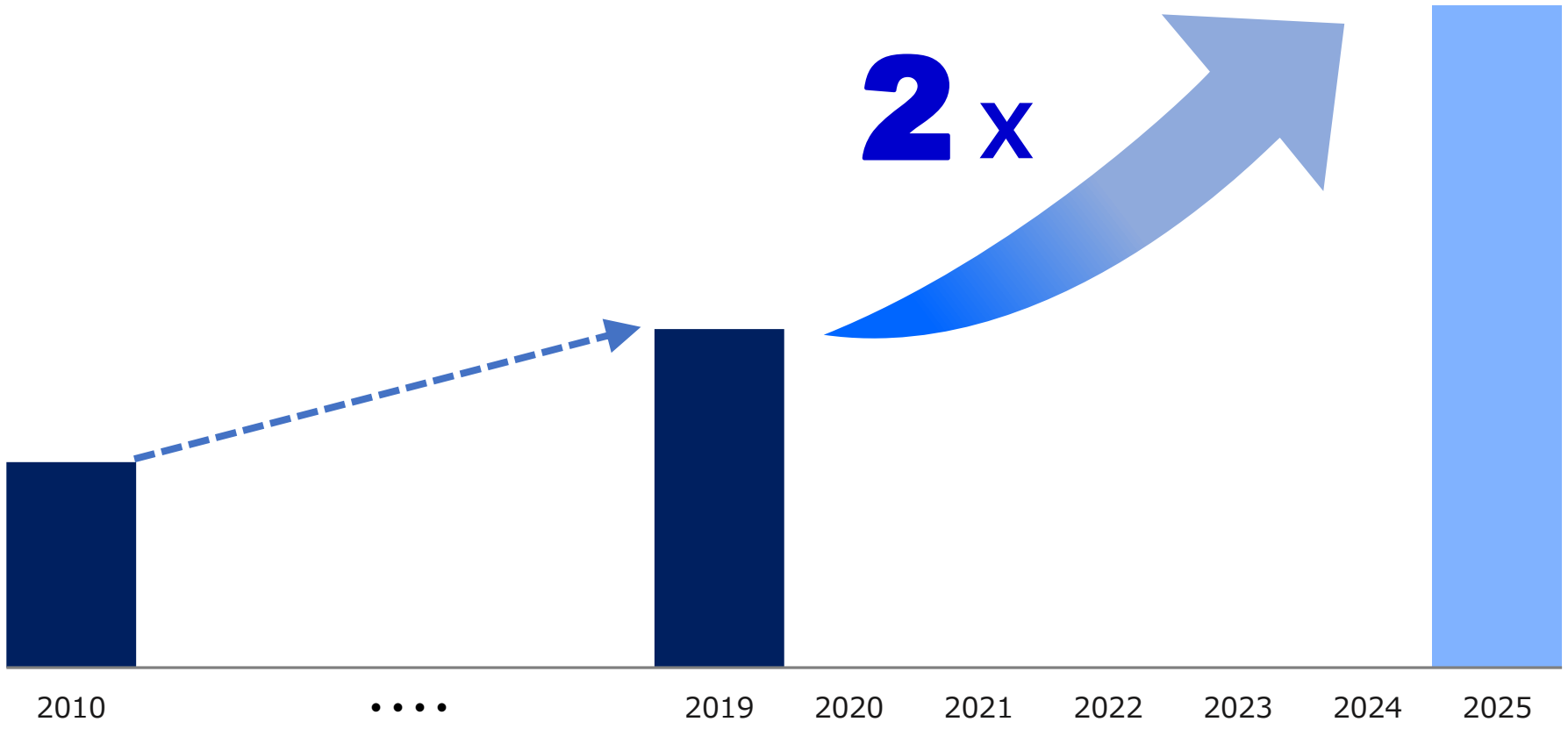


Image of sales growth of Electronic Materials Business