SUMITOMO ELECTRIC
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Sumitomo Electric Group Magazine

vol.21

Innovative Development,
Imagination for the Dream,
Identity & Diversity

Feature

Contributing to the Global Environment and Energy Infrastructure

Potential of Celmet™ Porous Metal

SUMITOMO ELECTRIC GROUP

Celmet™, a Key Material for Efforts to Achieve a Decarbonized Society

— Ensuring global supply toward an emerging hydrogen society —

Hydrogen has attracted much public attention in the initiative to realize a decarbonized society and carbon neutrality by 2050. This arises from its capacity to generate electricity through chemical reactions. Notably, hydrogen exhibits a remarkable energy density during combustion, and the resulting byproduct is water, which can be recycled. Importantly, these processes are entirely devoid of CO_2 emissions. In addition, hydrogen can be produced from water, thus high expectations are placed on hydrogen for its potential.

Hydrogen production systems and fuel cells are indispensable to realize a hydrogen society. Celmet™, a porous metal developed by the Sumitomo Electric Group, is expected to be used as an electrode material for hydrogen production systems, which generate hydrogen through electrolysis of water, and as components for fuel cells. Recently, Celmet™, which has a 50-year history, has been used for nickel-metal hydride (Ni-MH) batteries installed in hybrid electric vehicles (HEVs). The Sumitomo Electric Group has maintained stable supply and contributed to reducing the environmental impact on society. This article reports the advantages of Celmet™, its background, and its huge potential in the global market in the future.

Structure of Celmet™ porous metal (magnified image)

Bent shape

Alloying and plating technologies

Development of Celmet™ Through Accumulated Manufacturing Technology

Celmet™ porous metal

— Celmet™ meeting the needs of the times, finding applications in PCs, cell phones, and HEVs —

Study on applications of a porous metal with a porosity of 98%

In 1967, a metal foam developed by Dunlop, a UK company, was introduced to Sumitomo Electric. This was Celmet™, whose trademark was later registered by Sumitomo Electric. The porous metal had a frame with a three-dimensional network structure. Conventional structures and manufacturing methods had limits to porosity. Celmet™, on the other hand, featured porosity (the percentage of pores to the whole volume) of up to 98%. This enabled gases and liquids to flow smoothly, and large amounts of materials to fill the pores. The contact area was also large. Manufacturing in different sizes was possible depending on the purpose. Unlike conventional products, Celmet™ was lightweight and demonstrated high strength. The team of engineers recognized huge potential and started R&D in 1970.

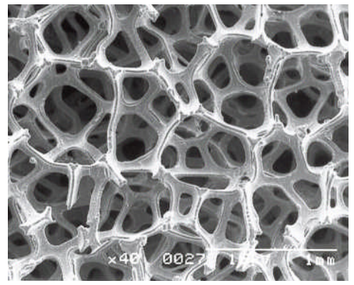
However, there was a question: for what purposes should the groundbreaking material be applied? Amidst the promising outlook for applications in batteries and catalyst supports, in 1974, a component designed for kerosene vaporizers was first brought to market. Subsequently, catalyst supports for automotive exhaust gas purification systems were developed, and R&D efforts were also undertaken to advance electrode materials tailored for batteries.

Achievement of continuous plating and successful application to Ni-MH batteries

In 1976, a prototype machine was introduced to manufacture long electrode materials for batteries, which were delivered to home electronics manufacturers. Development of continuous plating technology was launched on a full scale. Continuous plating systems derived from the same prototype are still in operation, and major and minor kaizen activities have been carried out. Significant cost reduction achieved by the equipment operation was pivotal in the history of Celmet™.

With the spread of notebook PCs and cell phones, the development of small and high-energy-density rechargeable batteries (secondary batteries) accelerated. For electronic devices, nickel-cadmium (Ni-Cd) batteries came into use at a relatively early stage. At first, porous metals manufactured by the sintering process were used for the positive electrodes of Ni-Cd batteries, but their porosity was only a maximum of around 80%. However, it was necessary to fill the electrodes with as much active materials as possible in line with the higher battery capacity. Celmet™, which is characterized by high porosity, was used for the first time in 1981. Subsequently, conventional materials were increasingly replaced by Celmet™.

Celmet™ was also used for the electrodes of Ni-MH batteries in line with the increase in battery capacity, resulting in widespread use of the material.



Celmet™ porous metal (magnified image)

At that time, Sumitomo Electric Toyama Co., Ltd. which is one of the Group companies, started to undertake mass production of Celmet™. In the auto industry, to meet the growing demand for environment-friendly cars, a Japanese automaker released the world's first HEV equipped with a hydrogen battery module in 1997. Celmet™ was used for the current collector of the Ni-MH battery. At that time, Hidetoshi Saito, who is currently the Managing Executive Officer, was in charge of the development of diesel exhaust gas filters for buses and trucks.

"Sumitomo Electric withdrew from the development of filters because it was difficult to set a practical goal in terms of performance and cost. In 2001, I was assigned to the Engineering Department of Sumitomo Electric Toyama. At that time, Ni-MH batteries, which were mainly used for cell phones and digital cameras, were increasingly replaced by lithium-ion (Li-ion) batteries, causing demand for Celmet™ to plummet and the business to go into the red," said Saito.

Despite growing momentum to withdraw from the business, members of Sumitomo Electric Toyama, including Saito, embarked on a project to drastically cut costs. There was demand for Ni-MH batteries in consumer applications other than cell phones and digital cameras. Cost reduction was the only solution to beat foreign competitors and survive.

"We solicited ideas from other members anyway. We identified 200 items to be addressed and made steadfast efforts to cut costs. Finally, we were able to attain the goal. This initiative helped strengthen the operations of the Celmet™ business, making it possible to maintain a surplus even after the Lehman Shock and the Great East Japan Earthquake," said Saito.

Efforts to completely eliminate metallic foreign matter

At that time, the first vendor of HEVs also had an advantage in terms of technology. Sumitomo Electric was the second vendor. Under these circumstances, contamination of Celmet™ with metallic foreign matter emerged as a major problem. Adhesion of foreign matter, including metallic dust, to Celmet™-based electrodes caused short circuits and loss of electrical function. Sumitomo Electric Toyama launched all-out efforts to completely eliminate metallic foreign matter from its manufacturing process. Rules were established to use an air shower and wash hands at the entrance to the plant and replace gloves for each work step, and the checking process was visualized. In addition, all equipment parts were overhauled, and analyzers were used for component analysis of each part. In this way, exhaustive plant management was conducted.

"These activities gave strengths to Sumitomo Electric Toyama, which was highly evaluated by customers. In addition to outstanding plant management, Sumitomo Electric Toyama was among the best in terms of manufacturing capabilities in the Sumitomo Electric Group based on objective indicators, including Monozukuri Fundamentals Assessment (MFA). The cost reduction efforts were also successful," said Saito.

Sumitomo Electric Toyama carefully responded to the needs of customers to cope with defects caused by contamination with metallic foreign matter. The company rose to the top vendor position, causing competitors to withdraw. Each time a new competitor entered the market, Sumitomo Electric Toyama enhanced measures against foreign matter as well as its cost reduction efforts to prevent market penetration. In 2019, production of Celmet™ hit a record high of one million m^2 in a single month.

Sumitomo Electric Toyama Co., Ltd.

Hidetoshi Saito
Managing Executive Officer (at the time of the interview)
General Manager, Electric Conductor & Functional Products Business Unit


Roll-to-roll production


Plating area


Heat treatment area


Processing area


Inspection

Manufacturing — Sumitomo Electric Toyama's commitment to manufacturing — Site with the World's Largest Production Capacity for Celmet™

Realizing high productivity and quality

Located near Shinminato Port, Toyama Prefecture, Sumitomo Electric Toyama was founded in 1973 with the operation of its aluminum continuous casting and rolling equipment. In the following year, the electric wire plant of Sumitomo Electric Toyama was completed, and it started the manufacture of aluminum high-voltage transmission lines. The company started the manufacture of Celmet™ in 1985 and reinforced the production system in 1994. With Celmet™ being increasingly used for HEVs, the company started to expand its production equipment in 2007. The current production capacity is 800,000 m^2 (average monthly production per year), which is the largest in the world.

Celmet™ is manufactured by electroplating nickel on urethane foam, which is the base material. Sumitomo Electric Toyama ensures both productivity and quality by using a two-step plating method, in which a high-speed uniform plating process is followed by a high-quality plating process. Subsequently, urethane and carbon are removed by heat. The thickness is then adjusted, and cutting is performed on the product width. This is how the products are finished. Appearance inspections are conducted to check the total length before shipment.

Realization of innovative "roll-to-roll" equipment

One of the innovative approaches in the series of manufacturing processes was the realization of "roll-to-roll." Ryuichi Yoshikawa, who is currently a director and the manager of the Manufacturing Department, was involved in this project. He engaged in research on Celmet™ at university. He was told, "If the research is successful, a cell phone will be made to fit into your pocket." He asked about the manufacturer, and learned that Celmet™ was manufactured by Sumitomo Electric Toyama. Anticipating that demand for Celmet™ would grow, he became motivated to join Sumitomo Electric Toyama.


Ryuichi Yoshikawa
Director, Manager of the Manufacturing Department
Sumitomo Electric Toyama Co., Ltd.

"After joining the company, I was put in charge of design of the manufacturing equipment. I found that the width of the production equipment was narrow and that the products were manufactured sheet by sheet. I told my supervisor that the productivity was low and loss was high. I proposed launching an innovative project to solve the problem, and the prototype of the current equipment configuration was developed. The objective was to expand the width of the raw material to one meter and develop "roll-to-roll" equipment, from plating to heat treatment to the inspection process. It was extremely difficult to design the continuous winding of Celmet™, a lightweight material, on a reel. Increased width would result in breakage, resulting in unsmooth flow. I asked for advice from other members, and spent about two years trying to achieve a stable product flow," said Yoshikawa.

Various measures were implemented to achieve low-tension transfer, design a system with fewer bends, and develop control to achieve low-tension regular winding and high-speed meandering. These efforts enabled us to build equipment capable of continuous production of the entire process.

Allocating resources to enhance the BCP to avoid the risk of disruption of operations

Tadashi Omura, who is currently the manager of the Quality Assurance Department, has been in charge of production engineering of Celmet™ since he joined the company. Omura, who was also in charge of customer relations, took the initiative to implement measures against contamination with metallic foreign matter.


Hitoshi Tsuchida
Director, Manager of the Engineering Department
Sumitomo Electric Toyama Co., Ltd.

"We implemented exhaustive measures to minimize contamination with metallic foreign matter in production equipment and prevent dust from being brought into the plant. We removed all possible risks, and the number of defects caused by contamination decreased steadily. I hope to ensure stable delivery of high-quality Celmet™ to customers through in-house cooperation and collaboration with raw material manufacturers," said Omura.

Junichi Nishimura, who is currently the manager of the Electronic Materials Plant (Celmet™ Plant), started to work on Celmet™ when this material came into use for in-vehicle batteries.

"I clearly remember the days when a problem occurred at a raw material supplier. We worked on site at a different supplier to start production. We demonstrated teamwork, which developed as we took measures against contamination with metallic foreign matter. This reminded me of the importance of business continuity planning (BCP). As the plant manager, I allocate resources to enhancing our BCP while always keeping in mind the risk of disruption of operations due to contingency," said Nishimura.

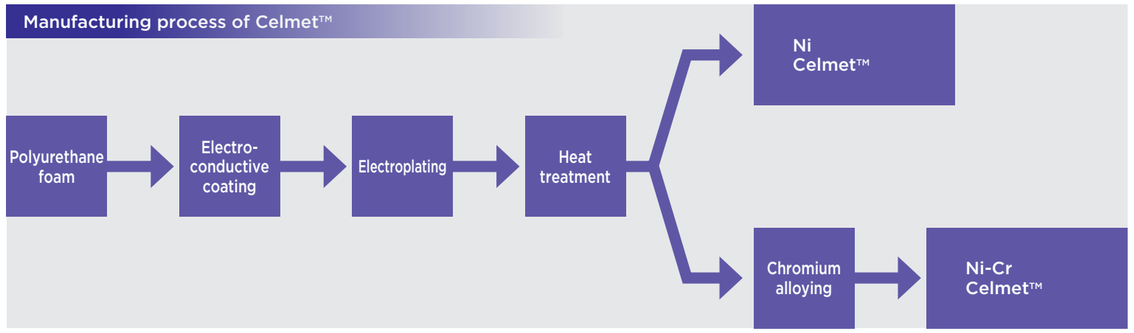
Raising the global profile and establishing a unique presence

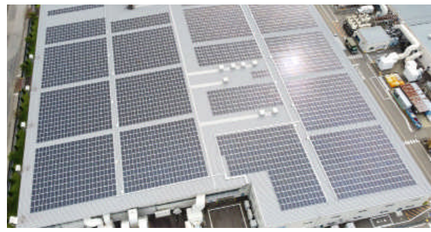
Efforts have been made to develop new technologies for Celmet™ for HEVs. The person in charge is Kengo Tsukamoto, who is the chief of the Electronic Materials Engineering Section. He works with Sumitomo Electric to develop a new Celmet™ for Ni-MH batteries.

"I am currently working on a project to improve the performance of Celmet™, whose mass production will start in two years. We also make proposals by offering samples for fuel cells and hydrogen production systems. The Celmet™ business is at a turning point, which we hope to leverage as an opportunity," said Tsukamoto.

Hitoshi Tsuchida, who is a director and the manager of the Engineering Department, led the Celmet™ production at Sumitomo Electric Toyama from an early stage.

"Celmet™ has various functions, including shielding performance and sound absorption. These functions are integrated into a single material. However, it is difficult to match such versatile functions with customers. Our predecessors underwent twists and turns until the material was used for batteries. Celmet™ has achieved success because we were able to overcome difficulties with reliable partners and suppliers. It is essential to build good relationships to share a vision to deliver good products. We have strengths in such overall capabilities. There are many challenges in the new deployment to hydrogen, but I hope to raise the global profile of Celmet™ and establish its dominant and unique presence," said Tsuchida.



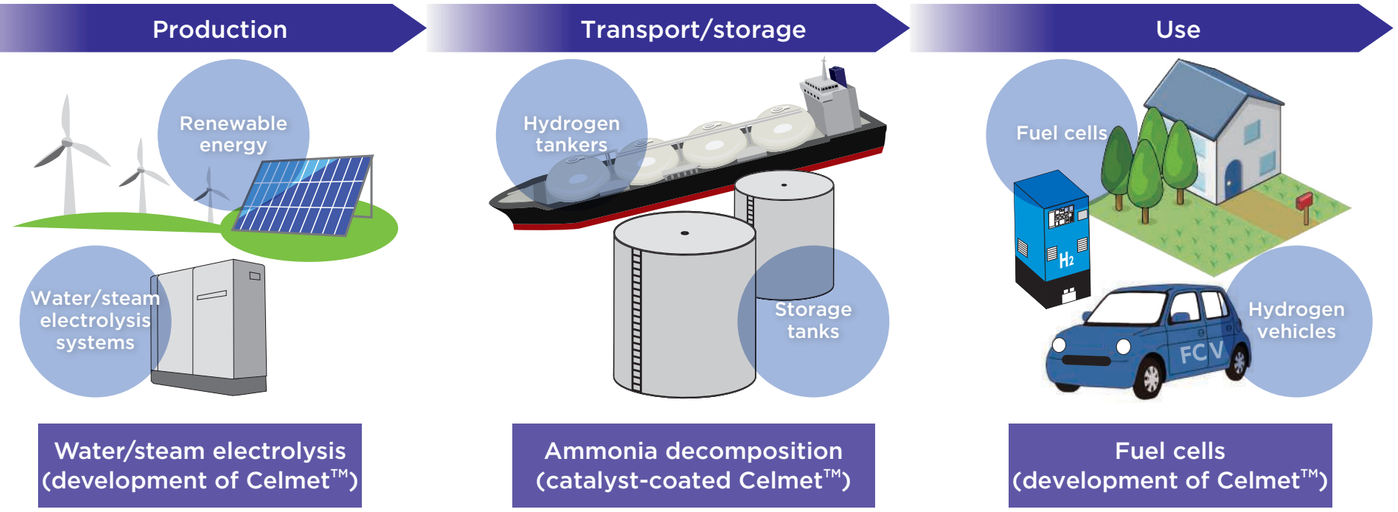

Solar panels installed on the roof of the plant. Sumitomo Electric Toyama aims to realize carbon neutrality by 2050 through active energy conservation and based on energy production technology.


Tadashi Omura
Manager of the Quality Assurance Department
Sumitomo Electric Toyama Co., Ltd.


Junichi Nishimura
Manager of the Electronic Materials Plant,
Manufacturing Department
Sumitomo Electric Toyama Co., Ltd.


Kengo Tsukamoto
Chief of the Electronic Materials Engineering Section,
Electronic Materials Engineering Department
Sumitomo Electric Toyama Co., Ltd.

Image of a hydrogen society



The Electrochemical Technology Group (Itami) develops device materials, which are indispensable for a hydrogen society.

Contribution to realizing a hydrogen society

Celmet™ development meetings, which are held in daily operations

Taking on Challenges to Apply Celmet™ Porous Metal

— To bring hydrogen society closer —

Celmet™, which contributes to Ni-MH batteries for HEVs

A Japanese automaker became the first in the world to develop an HEV. Both a gasoline engine and an electric motor were installed to drive the vehicle, which was designed to use electricity as much as possible to improve fuel efficiency and reduce CO_2 emissions. Celmet™ was used as the material for the Ni-MH battery installed in the HEV. The material contributed to the spread of environmentally friendly HEVs and the reduction of CO_2 emissions. Ni-MH batteries are characterized by long service life when they are used in HEVs subject to many charge-discharge cycles. They are also resistant to low temperatures and ensure high levels of safety. The Sumitomo Electric Group has been working to develop hydrogen-based applications by harnessing technologies and production capabilities refined in the development of Ni-MH batteries.

Fuel cell evaluation equipment

Application to solid oxide fuel cells (SOFCs)

R&D on Celmet™ is conducted by the Electrochemical Technology Group, Metals & Inorganic Materials Dept., Energy & Electronics Materials Laboratory of Sumitomo Electric Industries, Ltd. Kazuki Okuno has been working on the development of Celmet™ for nearly 20 years since he joined the company.

"I started working on Celmet™ in 2005 when defects were occurring due to contamination with metallic foreign matter. After the problem was solved, the use of Celmet™ for HEVs increased rapidly. However, we already had a sense of crisis over the decreasing demand at that time. We started to study new applications in 2008. One of the possible applications was fuel cells to generate electricity using hydrogen," said Okuno.

There are two ways to generate electricity using hydrogen. One is to use the thermal energy generated during the combustion of hydrogen, and the other is to directly convert hydrogen and oxygen into electrical energy. The latter is the process used in fuel cells, which have attracted public attention due to their high energy conversion efficiency. Home fuel cells are already widely used, and commercial and industrial fuel cells have also started to spread. High expectations are placed on further applications since fuel cells are clean with their only reaction product being water. Notably, solid oxide fuel cells (SOFCs), which operate at high temperatures over 700°C, offer an advantage of eliminating the need for expensive rare materials, including platinum catalysts. Koma Numata works on R&D to apply Celmet™ to current collectors.

Water electrolysis performance evaluation equipment

"Flexible current collectors are preferable for SOFCs, so the application of Celmet™ is expected to improve their performance. One problem is that oxidation deterioration is caused by the air that is fed into SOFCs. Development of Celmet™ using nickel-cobalt alloys is under way. The physical properties of cobalt prevent functions such as electrical conduction and gas diffusion from being affected even after oxidation," said Numata.

Kazuki Okuno
Assistant General Manager, Electrochemical Technology Group,
Metals & Inorganic Materials Dept.,
Energy & Electronics Materials Laboratory

The application of Celmet™ to SOFCs is a new challenge in the fuel cell market. Practical application is close at hand due to the cutting of costs through minimization of cobalt use and by optimizing the composition ratio between nickel and cobalt and the Celmet™ structure for gas diffusion.

Application of Celmet™ to hydrogen production systems

Meanwhile, Okuno is responsible for the application of Celmet™ to hydrogen production systems. In these systems, water is electrolyzed to produce hydrogen. R&D is under way to apply porous metals to electrodes for water electrolysis.

"Application of Celmet™-based electrodes with a high specific surface area will further increase the efficiency of water electrolysis. The bottleneck in water electrolysis is high power consumption. Application of Celmet™ is expected to reduce power consumption for hydrogen production. We hope to lower the water electrolysis voltage by developing nickel surface modification technology," said Okuno.

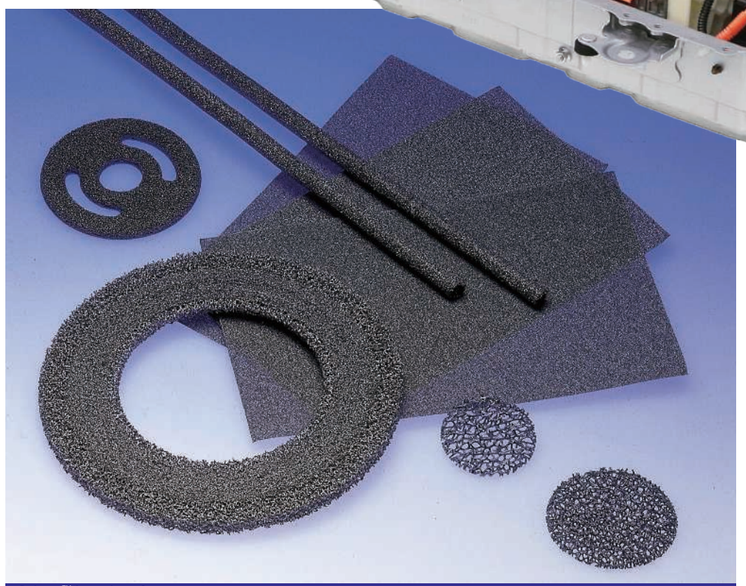
As Okuno pointed out, it is an important engineering challenge to increase the efficiency of water electrolysis. High power consumption also affects the running cost and poses a stumbling block in realizing, expanding, and spreading a hydrogen society. In this context, cost reduction in hydrogen production using Celmet™ has attracted much public attention. In Japan, a demonstration project using hydrogen production systems has just begun. The market is expected to start growing rapidly between 2025 and 2030, with market size expanding by factors of ten in the following 20 years. New applications of Celmet™ will emerge in the not-so-distant future.

Koma Numata
Assistant Manager, Electrochemical Technology Group,
Metals & Inorganic Materials Dept.,
Energy & Electronics Materials Laboratory

Contributions of Celmet™ to the Realization of a Decarbonized Society

— Focusing on “fuel cells” and “hydrogen production systems” —

Ni-MH battery pack for HEV



Celmet™ in various forms

Efforts to gain customers for fuel cells and hydrogen production systems

At the forefront of sales operations are three members of the Celmet Group, Energy Devices Sales Div. of Sumitomo Electric. Masaki Yamaji, who is the head of the group, has been working on Celmet™ for seven years. He pointed out that the business has entered a new phase.

“The commercial value of Celmet™ has improved thanks to support from many customers, including in-vehicle battery manufacturers. We will continue to ensure the stable supply of products that meet customers’ needs and contribute to their production activities. In line with the decarbonization trend, efforts have been accelerated to promote the social implementation of hydrogen energy. Our new mission is to work with the R&D staff and gain customers for our fuel cells and hydrogen production systems,” said Yamaji.

To accelerate product development, the New Business Development Section was established at Sumitomo Electric Toyama in 2022. Meanwhile, the Sales Group, including Yamaji, launched overseas promotion activities by revamping the Celmet™ website and through digital marketing. At present, more than 100 inquiries are received annually, and the number of promising projects has been increasing at customers, mainly hydrogen production system manufacturers.

Making proposals globally in collaboration with overseas group companies

Yumie Kikuchi and Erina Hagihara, who are in their sixth year and third year at the company, respectively, are in charge of sales of Celmet™ with Yamaji. They contact manufacturers of fuel cells and hydrogen production systems.

Kikuchi, who is in charge of sales in Japan, said: “It is crucial to identify the needs of hydrogen production system and fuel cell manufacturers in Japan as the manufacturing methods and required product properties, including high thermal resistance and long service life, vary. If a customer needs an alloy-based Celmet™ derived by material modification, we develop a new Celmet™ in collaboration and cooperation with the R&D Group to meet the requirements. We need to work as a partner of manufacturers, not as a supplier. This gives me a sense of fulfillment.”

On the other hand, Hagihara is in charge of sales overseas, where the market for hydrogen production systems is ahead of Japan's domestic market. The company seeks to be designed into systems at an early stage. Last year, they made progress in negotiations with a new business partner. “The customer is an Israeli manufacturer that became interested in our products after we responded to their inquiry. Following a plant tour of Sumitomo Electric Toyama, we coordinated the specifications. Eventually, we received an order to fabricate a prototype. We must not assume a passive attitude in overseas sales. We hold workshops and share information so that respective group companies can take the initiative in activities through the overseas sales network. We were able to receive the order in cooperation with a sales company in Europe,” said Hagihara.

At present, the profile of Celmet™ is not high. Sumitomo Electric Toyama will actively access promising markets and propose competitive applications both on the web and through participation in overseas exhibitions.

Huge potential of Celmet™

It is interesting to know how Celmet™ has survived. Demand for Ni-MH batteries decreased in the 2000s when Li-ion batteries started to gain market share. It was often expected that production of and demand for Celmet™ would decline. However, the business has overcome difficult situations and recovered from a temporary setback each time. Managing Executive Officer Hidetoshi Saito, who has experienced these developments, sees huge potential for Celmet™ in the future.

“Li-ion batteries installed in electric vehicles (EVs) are highly regarded for their high energy efficiency and high capacity. However, they are not the ultimate solution and are deployed as a makeshift measure. Li-ion batteries pose safety concerns and are inferior to Ni-MH batteries in terms of durability. All-solid-state batteries, which will replace Li-ion batteries, are under development, to which Celmet™ is highly likely to be applicable. In the future, fuel cell vehicles (FCVs), which drive by generating electricity through a chemical reaction between hydrogen and oxygen, are also expected to increase in addition to EVs. Celmet™ is useful in all steps of hydrogen use. It can be used not only for fuel cells but also for catalyst supports for the production, transport, and storage of hydrogen. I am convinced that Celmet™ will contribute significantly to a hydrogen society in the future,” said Saito.

Saito gave an encouraging message to younger employees. “I expect that you will do your utmost in your work. This will provide you with new findings and enable you to experience the joy of work through personal development. The Sumitomo Electric Group also has a culture where other members support you when you face a difficulty. I hope you will further develop the Celmet™ business with other members,” said Saito.

Nurtured by the predecessors of the Sumitomo Electric Group, Celmet™ has marked its 50th anniversary. How will Celmet™ be passed on over the next 50 years? The future deployment of Celmet™ toward the next generation deserves your attention.

Photo taken with personnel of the customer, an Israeli manufacturer of hydrogen production systems. Behind them is a hydrogen production system. (Hagihara is second from the right.)

“We will continue to ensure the stable supply of Celmet™ depending on customers’ needs and meet the expectations of our customers, including manufacturers of in-vehicle batteries. Hydrogen-related fields have huge potential, so we will achieve further growth of Celmet™ by offering new value.”

Tomoyuki Aoki
General Manager, Energy Devices Sales Div. Electronics Sales Unit

Celmet Group, Energy Devices Sales Div. Electronics Sales Unit of Sumitomo Electric
From left: Head of the Group Masaki Yamaji, Yumie Kikuchi, and Erina Hagihara

id Special Feature

Aiming to Enhance Medium- and Long-Term Corporate Value by Steadily Promoting “Growth Strategies” and “Strengthening Business Foundations” with the Integrated Capabilities of the Group

Osamu Inoue
President & COO,
Sumitomo Electric Industries, Ltd.

Overall concept of the 25M

The Medium-term Management Plan 2025 (“25M”), which was formulated recently, serves as the first milestone of the 2030 VISION, the long-term vision, to realize a “Glorious Excellent Company,” which is what the Sumitomo Electric Group strives to be. The overall concept of the 25M is to steadily promote “Growth Strategies” for business, which aim to evolve our technologies further to meet the challenges of this era of change, and “Strengthening Business Foundations,” which aims to strengthen our management foundations to build a corporate structure that is resilient to change, with the integrated capabilities of the group under the slogan of “Creating a Green Society through our Connecting and Supporting Technologies,” thereby enhancing the medium- and long-term corporate value.

Society and economy facing various difficulties and entering a major transition period

Since its founding in 1897, the Sumitomo Electric Group has improved various technologies like a family tree based on the copper wire and cable business, which originated from Sumitomo’s copper business. It has offered highly functional and high-performance products that contribute to a “safer and more comfortable” society and support infrastructure and various industries. Teigo Iba, the second Director General of the Sumitomo Family, left the following message: “Sumitomo’s business must benefit not only Sumitomo itself but also the nation and society in general.” The management approach of always ensuring harmony with the public interest and solving social issues has been fully passed down to the Sumitomo Electric Group.

Meanwhile, modern society faces various difficulties, including the intensification of global warming, pandemics of infectious diseases, natural disasters, and military conflicts.

The major social and industrial transformation, including GX,*1 DX,*2 and CASE,*3 will continue to move forward.

The Sumitomo Electric Group has a wealth of business experience in all these fields and an advantage based on its track record in terms of technology. We consider such a major transformation as a golden opportunity toward sustainable growth.

Against this backdrop, we formulated the Sumitomo Electric Group 2030 VISION, a long-term vision toward 2030, in May 2022, to present the grand vision of the Sumitomo Electric Group and share understanding among all group employees in the period of major transformation when accurate, quick, and flexible action is required. The 2030 VISION clearly states that the group will unleash all of its capabilities toward realizing a “safer and more comfortable” society, to which the group has been committed since its foundation, and making our society “green” and environmentally friendly.

*1: Abbreviation for “Green Transformation,” to shift the industrial and social structure from fossil energy to clean energy
*2: Abbreviation for “Digital Transformation,” to improve people’s lives by spreading advanced IT
*3: Acronym for “Connected,” “Autonomous,” “Shared & Services,” and “Electric.” The transformation aims to restructure the automotive society through powertrain innovation (power source), ecology (environmental protection), safety and security, and intelligence (information).

Overall Concept

“Creating a Green Society through our Connecting and Supporting Technologies”

Sustainability initiatives | Mutual prosperity with multistakeholders → Enhancement of medium- and long-term corporate value

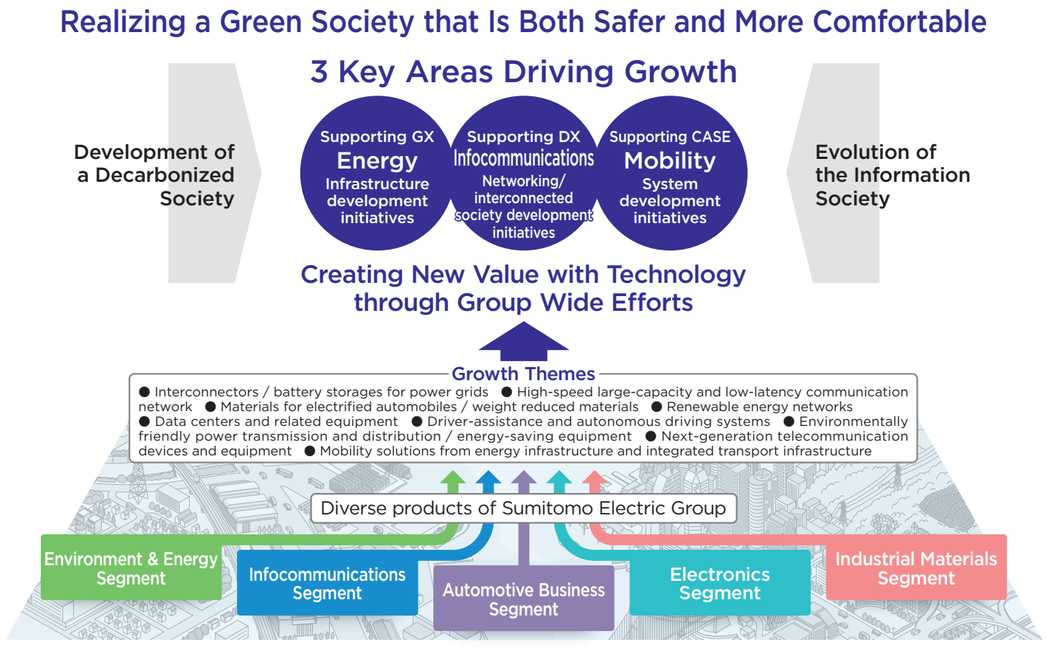
id Special Feature

Enhancing our sustainability initiatives to achieve shared prosperity with our stakeholders

25M Growth Strategies

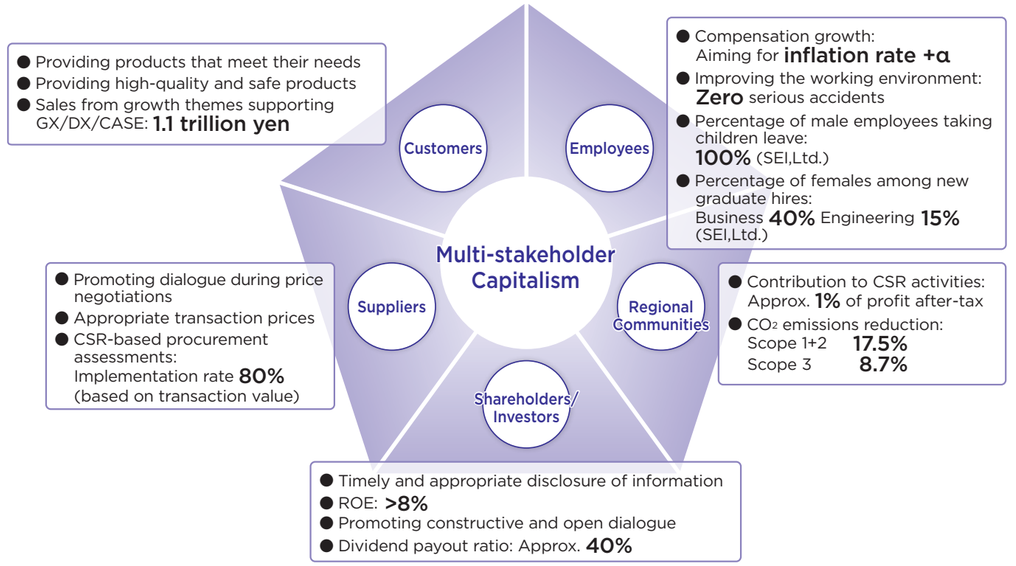
In the Growth Strategies, nine groups of products and services that are expected to grow in particular in the respective key areas of energy, infocommunications, and mobility are designated as “growth themes,” in line with the development of a decarbonized society and the evolution of an information society. We will reliably seize business opportunities on these themes for various groups of products in each segment. We plan to increase net sales related to “growth themes” to about 1.1 trillion yen, up 400 billion yen from the FY2022 level, by FY2025. The Sumitomo Electric Group also operates important businesses, which are linked to the Genealogy of Technology evolved from the foundation of the copper wire and cable business, which support society, and whose value cannot be determined based solely on profitability. We have a mission to continue developing these businesses.

3 Key Areas



Key indicators and targets

Net sales	Operating profit	Before-tax ROIC	R&D	Capital Investment
4.4 trillion yen	250 billion yen	>8%	360 billion yen/3 years	720 billion yen/3 years



Multi-stakeholder Capitalism

The 2030 VISION reconfirms the unwavering basic policies of the Sumitomo Spirit and Sumitomo Electric Group Corporate Principles, both of which have been passed down to today. “With our focus on contributing to the public benefit, the Sumitomo Electric Group strives for mutual prosperity with all of our stakeholders” is our management policy. The 25M states that cooperation with multistakeholders is indispensable for our sustainable growth and enhancement of our medium- and long-term corporate value. It also aims to steadily return the results of our growth to our multistakeholders, namely, our customers, employees, suppliers, regional communities, and shareholders/investors. As practice of Multistakeholder Capitalism, we presented the specific indicators and targets in addition to the overall financial indicators. We are confident that this is a major characteristic of the 25M.

At present, the Sumitomo Electric Group has about 290,000 employees at over 400 group companies across many countries and regions, deploying business operations globally. We will continue to maximize the group’s energy and competitiveness by leveraging the quality and capabilities of its talents. We will make efforts to fulfill the 25M so that we can meet the expectations of our stakeholders.

I would like to take this opportunity to ask for your further understanding and support for our group.

To learn more about the 2030 VISION and the 25M, scan the codes on the right.

2030 VISION ➡

25M ➡

A Place Related to Sumitomo's History

— Osaka —

The Site of Sumitomo Copper Smelting Works

Sumitomo's close relationship with Osaka dates back to the early Edo period (1603 –1868), when Tomomochi Sumitomo, the second head of the family, opened a copper refinery in Osaka to start copper refining and smithing business. Ever since then, Sumitomo has developed its business particularly in Osaka. This article sheds light on the site of the Sumitomo Copper Smelting Works where Sumitomo's business in Osaka originated.

Sumitomo Copper Smelting Works

The site of the former Sumitomo Copper Smelting Works is located in Chuo Ward, Osaka City, and is now maintained as a park. This large refinery, which once represented copper refining in Japan, was established by Tomomochi Sumitomo, the second head of the Sumitomo family. Tomomochi's father-in-law, Masatomo Sumitomo, the founder of the House of Sumitomo, established Sumitomo's business philosophy, and Tomomochi's biological father, Riemon Soga, developed the nanban-buki copper smelting technique. During the Edo period, Osaka was central to the copper smelting industry, and the Sumitomo Copper Smelting Works was the largest refinery in Japan. In its prime, the refinery had premises covering an area of about 2,500 m^2, where more than 100 workers smelted copper ore, producing about one third of Japan's copper output. Today, a refining furnace that once belonged to the facility is exhibited at its site. After the refinery was shut down, a Sumitomo family residence was built at the site. In 1879, a Western-style house and a garden was constructed there along with a billiard hall to the east, which was Japan's oldest independent hall dedicated to this pastime.

Kodo Zuroku (illustration of the process from copper mining to smelting; in the custody of Sumitomo Historical Archives)

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