SUMITOMO ELECTRIC
Connect with Innovation

id

Sumitomo Electric Group Magazine

vol. 17

Innovative Development,
Imagination for the Dream,
Identity & Diversity

Feature

A Challenge to Resolve Issues Concerning Rare Metals Tungsten

A path toward complete recycling

SUMITOMO ELECTRIC GROUP

Tungsten, One of the Rare Metals

– To ensure a stable supply and achieve a recycling-oriented society –

Many mineral resources are available on our planet. They are used for various applications and are indispensable in our daily lives. Iron, aluminum, and copper are called “base metals,” and are abundant in both reserves and output. There are also other metals called “rare metals.” According to Japan’s Ministry of Economy, Trade and Industry, rare metals are metals whose available quantity on our planet is very small, which are difficult to extract for technical and economic reasons, and whose stable supply is important from the viewpoint of national policy. Tungsten (element symbol: W) is one of these rare metals. Named for the Swedish word for “heavy stone,” tungsten has unique characteristics. It is a high-melting-point metal, with a melting temperature of 3,380°C (to 3,653°C). The hardness of cemented carbide, which is derived by mixing tungsten carbide (WC) powder with cobalt (Co) and other binders and then pressing and sintering the mixture, is second only to that of diamond. Other known characteristics include a high specific gravity, a low thermal expansion rate, and high radiation-shielding performance. Tungsten is used in various industrial applications, such as cutting tools, machine parts, electrode materials, and heat radiation materials. The problem is that tungsten reserves are found in only limited regions and the supply is unstable.

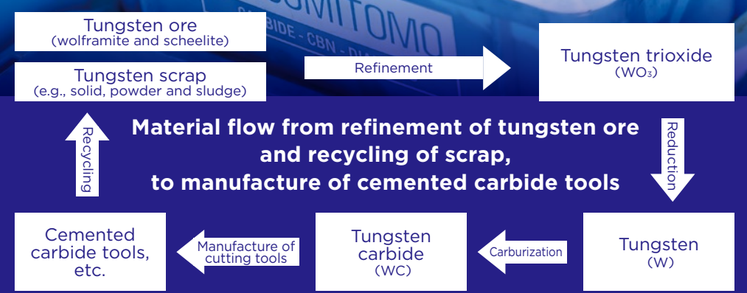
Various cutting tools using hard metals (e.g., cemented carbide) available from the Sumitomo Electric Group cannot be manufactured without tungsten. In an effort to seek a sustainable and stable business, the Sumitomo Electric Group has achieved tungsten recycling on a commercial basis by developing a new technology and establishing a new system. This helps achieve a stable supply and corresponds to the target of “achieving the sustainable management and efficient use of natural resources” in “responsible consumption and production,” which is one of the United Nations’ Sustainable Development Goals (SDGs). Namely, the recycling business aims to help achieve a recycling-oriented society and contribute to reducing the environmental impact and protecting the natural environment. This feature article focuses on the history of the Sumitomo Electric Group’s efforts to recycle tungsten.

Tungsten ore.
The percentage of tungsten contained in the ore is less than 1%.

Open-pit mining of tungsten
(Nui Phao mine in Vietnam)

Sorting of cemented carbide tools and drills

Sumitomo Electric's collection box for recycling, and cemented carbide cutting tools collected



Igetalloy Scrap Center, where cutting tools are collected

Sorted scrap waiting to be shipped to A.L.M.T. Corp. and other destinations

A Challenge to Build a Tungsten Recycling System

– Achieving a stable supply, which has been a pressing issue –

Securing rare metals, the top-priority national issue

Japan depends on imports for most of its energy and mineral resources. At present, there are no mines in Japan that produce rare metals, including tungsten. For this reason, ensuring the stable supply of energy and mineral resources is one of most important national issues. Against this backdrop, the Ministry of Economy, Trade and Industry formulated the New National Energy Strategy in 2006. It mentioned the need to step up efforts to promote recycling of metallic mineral resources. The Guidelines for Securing Resources, which were established in 2008, set out a policy to support the acquisition of important resources, including rare metals. In the following year, the Strategy to Secure Rare Metals was published. In 2012, five minerals—neodymium, dysprosium, tantalum, cobalt and tungsten—were selected as priority minerals to be recycled. A national project is under way to secure these rare metals.

Why are rare metals so important? Although they are consumed in small quantities, they are indispensable materials in the manufacture of LCD TVs, mobile phones and vehicles. In fact, they are essential in maintaining and strengthening the international competitiveness of Japan's manufacturing industry. Notably, global demand for rare metals is expected to increase in the fields of next-generation vehicles, motors and storage batteries, which are expected to come into widespread use in the building of a low-carbon society. In terms of the use of tungsten, cemented carbide accounts for about 61% of the global market on average. In Japan, the percentage of cemented carbide is particularly high (about 76%).* Derived by mixing WC with cobalt (Co), cemented carbide achieves high hardness, high wear resistance, and high heat resistance. Cemented carbide tools, such as drills, and cemented carbide inserts for cutting tools have achieved high-speed machining and revolutionized the operation of manufacturing and machining sites. In Japan, the Sumitomo Electric Group has become one of the pioneering companies of this technology. Cemented carbide tools are crucial for many manufacturers. It is safe to say that these tools are the lifeline of manufacturing and machining. Tungsten is an essential material in the production of these tools.

* Source: Statistical Report 2013 published by the International Tungsten Industry Association (ITIA)

Expansion of scrap collection and processing capacity required to meet the goal

The Japanese government has set the procurement of rare metals as a national project due to changes in the environment surrounding rare metals. From the latter half of the 20th century to date, the framework of the global economy has changed significantly due to the rise and development of emerging countries, including China. Global production and consumption have accelerated, resulting in the expansion of consumption of rare metals. Against this backdrop, there has been a rising tide of resource nationalism (the belief that the resources available in a country should be managed and developed by that country) among producing countries. Tungsten is no exception. Previously, Japan imported much of its tungsten from China, which accounted for more than 80% of the global production volume. Today, tungsten is a mineral subject to export control in China. The production volume in other countries, including Vietnam and Russia, is limited. It is evident that tungsten will be depleted in the near future.

Under these circumstances, the Sumitomo Electric Group has embarked on the recycling of tungsten. This is a challenging project to free the company from dependence on imports and achieve a stable supply by recycling tungsten. The Administrative Dept. of the Advanced Materials Business Unit is responsible for procuring metallic materials for cutting tools, including tungsten. General Manager Yoshimitsu Okamori is one of the members who have led the efforts to recycle tungsten.

Visits to tungsten mines are an important part of the team's work (Okamori is on the right)

"One of the tasks of our department is to strengthen the material flow from ore and scrap to the manufacture of cemented carbide tools, which are the final products. Our solution was to establish a recycling technology and a recycling center in the U.S. [discussed below]. The Sumitomo Electric Group started recycling tungsten in the 1980s. At that time, a recycling process called the "zinc process" was used to recycle scrap into raw material powder while retaining its constituents. In 2011, Sumitomo Electric developed a new chemical process to recycle scrap into tungsten trioxide (WO_3), making great strides in recycling. Today, the recycled volume is equivalent to the weight of the cemented carbide tools sold by the Sumitomo Electric Group in Japan. However, this does not necessarily mean that Sumitomo Electric products accounted for 100% of the collected scrap. Part of the scrap was exported as valuables or melted with steel scrap. Of the total scrap generated in Japan, an estimated 30% is returned to our group. As the first step, we hope to increase the percentage to about 50%.

Yoshimitsu Okamori
General Manager, Administrative Dept.
of the Advanced Materials Business Unit

To this end, we must expand both the collection capacity and the processing capacity. In terms of achieving stable supply, we are studying the possibility of investing to acquire interests in mines in addition to promoting recycling," said Okamori.

Systematic scrap collection

Cemented carbide scrap is classified into two main categories: solid hard scrap and powdery soft scrap. The former includes used or defective cutting tips, drills and dies/molds, while the latter refers to powder sludge generated during grinding and polishing at manufacturers of cemented carbide materials and cemented carbide tools. The sorting and collection of such scrap are crucial processes in the completion of a recycling system. When Sumitomo Electric started to recycle scrap in the 1980s, it also started to collect scrap. Recycling collection boxes are made available to customers, which use cemented carbide tools. The boxes, which are used to sort cemented carbide tools and other materials, are collected periodically. The company also accepts scrap from competitors' products. It has also started collection by using a home delivery service. All the cemented carbide scrap collected is transported to the Igetalloy Scrap Center for sorting. The entire collection process is undertaken by Sumitomo Electric Tool Net, Inc., which sells cemented carbide tools. Shinji Nakao, General Manager of the Environment and Resources Sales Dept. of Sumitomo Electric Tool Net, has been engaged in the collection from the outset.

"Recycling of cemented carbide scrap is important partly because it is highly effective in terms of environmental conservation. The percentage of tungsten contained in ore is less than 1%. Meanwhile, the percentage of tungsten contained in cemented carbide tools is about 85%. From the viewpoint of refining efficiency, it is far more environmentally friendly to extract tungsten from the scrap of cemented carbide tools. It should also be noted that global tungsten reserves are estimated at about 3.2 million tons. Thus, the resource is likely to be depleted in the near future. Global competition for tungsten will intensify. We must further expand the scope of recycling to protect Japan's manufacturing industry. While such efforts partly reflect our business strategy to encourage customers to use Sumitomo Electric products, we will publicize the importance of recycling through activities to foster motivation and raise awareness with the SDGs in mind," said Nakao.

Shinji Nakao
General Manager, Environment and Resources Sales Dept.
Sumitomo Electric Tool Net, Inc.

Scrap cast into a molten salt dissolution furnace

New Technology That Achieved an Innovative Recycling System

– A bold challenge to achieve the oxidation wet-chemical process –

A path toward the recycling and stable supply of tungsten

In recycling of cemented carbide tools, a direct process called the “zinc process” had previously been used. In this process, which the Sumitomo Electric Group carried out for many years, solid hard scrap is heated and melted together with zinc. Subsequently, only zinc is removed to obtain spongy cemented carbide, which is pulverized and recovered as recycling powder. Simply put, the constituents are directly recycled into powder. The zinc process is beneficial in that its consumption of chemicals and energy is small. However, it has a big problem. Specifically, it can remove impurities that volatilize in a high-temperature process, but it cannot increase the purity or adjust the size of the powder particles, resulting in limited scope for reuse. Under these circumstances, the Sumitomo Electric Group took on the challenge of achieving the complete recycling of cemented carbide. The objective was to obtain raw materials, which were equivalent to those derived from ore refinement, from collected scrap. If this could be achieved, recovered cemented carbide would be usable for various purposes, opening the way toward the stable supply of tungsten. It was therefore necessary to develop a new tungsten recycling technology to replace the zinc process.

High-purity recycling to obtain widely usable raw materials

The challenge to develop a new technology was launched in response to the surging price of tungsten in 2005. The price had almost quadrupled from the previous year. The risk of dependence on China materialized. The development a new tungsten recycling technology started in 2007 through participation in a project under the auspices of Japan Oil, Gas and Metals National Corporation (JOGMEC) named the “project to develop a highly efficient system to recover rare metals, etc.” Sumitomo Electric, Sumitomo Electric Hardmetal Corp., A.L.M.T. Corp., and Nagoya University participated in the joint research project, which aimed to develop a new recycling technology capable of highly efficient processing even on a small scale by focusing on cemented carbide scrap. A.L.M.T., a Sumitomo Electric Group company in the industrial materials segment, took on the leadership role. The company focuses on two businesses: the refinement, manufacture and processing of high-melting-point metallic materials, such as tungsten and molybdenum, and the manufacture and precision machining of diamond precision tools. Minoru Tsunekawa, who was a member of the project to develop a new recycling technology and is currently Engineering General Manager of the Powder Alloy Division & Hard Metal Division of A.L.M.T. , said that the ultimate goal of the new recycling technology was to obtain high-purity WO_3.

“The usage of recycled powder derived from the zinc process was limited. The powder was only usable as a raw material for cemented carbide. Thus, recycling in a broad sense had not been achieved. Recycling means obtaining raw materials that can be used flexibly and widely. It was necessary to restore the condition before the material had been processed into WC. The objective was to obtain a raw material whose quality was equivalent to that of refined ore (namely, high-purity WO_3). It was also necessary to handle various types of scrap. The new recycling technology to achieve the goal is an oxidation-wet chemical process, whereby scrap is chemically dissolved and melted to recover its constituents. We faced difficulties in establishing the technology,” said Tsunekawa.

External view of A.L.M.T.

Overview of the new oxidation-wet chemical processing building

Ion exchange building

Molten salt dissolution furnace

Roasting furnace

WC powder manufactured

High efficiency achieved by the ion exchange resin process

One of the difficulties that Tsunekawa mentioned was the development of molten salt dissolution technology. To obtain WO_3, it is necessary to perform oxidizing roasting of scrap of cemented carbide tools and then to chemically dissolve the product to prepare a solution. However, this process cannot oxidize the insides of scrap materials. The processing cost is high because reoxidation is required. Tsunekawa and other members tackled this issue.

“In our development technique, we dissolved sodium nitrate ($NaNO_3$), whose oxidizability is high, together with scrap of cemented carbide tools, and allowed the solution to react with sodium while performing oxidation. This technique had the advantage that the oxidation processing reached the insides of the scrap materials. However, it posed a big problem. The oxidation reaction was accompanied by the generation of a large amount of heat. We had to consider how to control the rapid exothermic reaction and ensure safety. After conducting an in-depth study, we optimized the supply volume of $NaNO_3$ (molten salt), making it possible to control the reaction,” said Tsunekawa.

Minoru Tsunekawa
Engineering General Manager, Powder Alloy Division & Hard Metal Division, A.L.M.T.

In the next phase, it was necessary to convert the resulting sodium tungstate (Na_2WO_4) solution into an ammonium tungstate ($(NH_4)_2WO_4$) solution. Tsunekawa and the other members aimed to achieve highly efficient conversion. They chose the ion exchange process, whereby the solution was allowed to flow through a resin tower filled with ion exchange resins. The tungstate ions contained in the Na_2WO_4 solution were adsorbed by the ion exchange resins, and were eluted by ammonium salt to obtain the $(NH_4)_2WO_4$ solution.

“The question was how to achieve high efficiency. While working on selecting optimal resins, we focused on the pH value, which represents acidity or alkalinity. We found a solution to achieve high efficiency by carefully controlling the pH value. We increased the efficiency of the ion exchange process to two- to three-fold that of the conventional technology. In other words, the tungsten adsorption volume increased two- to three-fold, so we were able to reduce the size of the equipment due to higher efficiency,” said Tsunekawa.

Expansion of the recycling business while seeking new solutions

The tungsten recycling system was completed after resolving various issues, including treatment of the exhaust gas, the development of an ammonia recovery and reuse system, and the study of appropriate recycling of powder scrap. The plant equipment started operation in 2010. After making improvements, commercial operation commenced in the latter half of 2011.

“We remain thoroughly committed to quality at every stage from obtaining scrap, which is the raw material, to the final process. We will further expand the recycling business. There isn’t enough space available to increase production at the Toyama Works, which currently serves as the production center, so we will study new methods,” said Tsunekawa.

The efforts to expand the recycling business, which Tsunekawa mentioned, are under way in the U.S. The next chapter will focus on the recycling project in the U.S., which is based on the oxidation-wet chemical process.

Tungsten Recycling to Start in the U.S.

– To establish a global recycling system –

Recycling system at NIRE

WO_3 powder manufactured

WO_3 powder shipped to A.L.M.T. in Japan

Tungsten trioxide (WO_3) manufacturing facility operated by Sumitomo Electric

In 2014, the Sumitomo Electric Group launched a business to refine tungsten ore and recycle scrap in the U.S. This business is operated by Niagara Refining LLC (NIRE), a joint venture between Sumitomo Electric U.S.A. Holdings, Inc., a wholly owned subsidiary of Sumitomo Electric and New York Tungsten, LLC, a subsidiary of Buffalo Tungsten Inc. (a tungsten powder manufacturer in the U.S.). NIRE produces WO_3, which is used to manufacture raw materials for cemented carbide tools and other products.

Previously, WO_3 was procured by A.L.M.T., one of the Group companies, from overseas, including China, to manufacture WC powder, which was used as the raw material for cemented carbide tools. With the establishment of NIRE, the raw material can be procured within the Sumitomo Electric Group. NIRE produces WO_3 by using both ore from tungsten mines and scrap collected from the market as raw materials. WO_3 is then delivered to A.L.M.T. and used as the raw material for manufacturing WC. The WO_3 production company was established in the U.S. for two reasons. First, the volume of scrap available was abundant from the viewpoint of deploying the recycling business globally. Second, the utility costs, including electricity, gas and water, could be reduced. Yuto Nishide currently serves as manager of the analysis department at NIRE. Previously, he had been assigned to A.L.M.T. to take care of the recycling operations. Subsequently, he acquired overall knowledge about the recycling of tungsten. In 2019, he was transferred to NIRE, whose recycling business had been accelerated by the arrival of Nishide. He was a process engineer of the manufacturing department. He was in charge of the recycling system when he assumed his position at NIRE, which was working to establish molten salt dissolution technology at that time. It should be noted that many issues remained unresolved.

Niagara Refining LLC Management Lab. Yuto Nishide

With the plant supervisor (on the right)

A problem in the filtration process to separate impurities

"It is extremely difficult to pulverize the scrap of cemented carbide tools into fine powder for recycling. A severe environment is created to dissolve the powder at high temperature. In Japan, $NaNO_3$, whose oxidizability is high, is used for dissolution. At Sumitomo Electric, sodium sulfate (Na_2SO_4) is used by focusing on the ease of handling and safety. The Na_2WO_4 solution is prepared in the same process as that used in Japan. The Na_2WO_4 solution contains impurities that remain undissolved, which must be separated in the filtration process. The first hurdle we had to overcome was the time required for the filtration process. We planned to complete the process in three hours, but it took from half a day to a whole day. The production volume was only a quarter of what we had planned. There must have been a bottleneck somewhere," said Nishide.

Nishide listed the possible factors and practiced PDCA to tackle the causes one by one. However, there were more diverse causes than expected. There was a bottleneck in each piece of equipment, such as the filtration system, the pump, the pipe, and the tank. Nishide involved engineers and the respective departments, including equipment, analysis and manufacturing, and resolved the issues through close cooperation. The equipment department worked to eliminate a bottleneck in the pipe and pump by selecting a new pump. The analysis department worked to identify impurities, which posed a bottleneck in the filtration system. It abolished a process whereby impurities were generated, and developed a new process. Process engineers worked to eliminate a bottleneck in the tank by changing the time of starting the filtration process as a kaizen measure in the process technology. The long-term kaizen efforts, which took several months, successfully attained the planned production volume. Nishide's initiative had a significant impact on NIRE. Almost all the employees were involved in resolving the issue. This helped build a sense of unity in the company and gave strong motivation to the employees to promote the recycling business.

Design and construction of mass production equipment to commence in FY2022

The recycling plant that is currently in operation is a prototype. The project is still in the experimental phase. We asked Naohiro Toda, Vice President of NIRE, about the current situation and the future outlook.

"The recycling business in the U.S. faces many issues. For example, the furnace deteriorates due to chemicals used in the molten salt dissolution process. Impurities other than tungsten dissolved in the water also cause corrosion of the furnace. The series of processes is performed in an ultra-high-temperature environment. Safety devices are activated when there are risks, resulting in frequent suspension of operation. Efforts have been made to tackle these issues based on various ideas and arrangements. We will promote kaizen by further accumulating technologies. The current production volume of WO_3 is about 75% of the recycling target. The actual production volume is lower than this value partly because we are still in the experimental phase. We will establish recycling technology by the end of FY2021 and design and construct mass production equipment by the end of FY2022, which will go into full operation in 2023. A global recycling system for integrated production from raw materials to the finished products of cemented carbide tools will be completed through recycling within the Sumitomo Electric Group. We will pursue synergies by optimizing production through collaboration within the Group," said Toda.

Achieving both stable supply and sustainability

Tungsten is not the only material that NIRE aims to recycle. While tungsten accounts for about 90% of cemented carbide tools, cobalt accounts for about 10%. Cobalt is also one of the rare metals. In Japan, it is one of the five priority minerals to be recycled. Efforts have been made to extract only cobalt from impurities, which had previously been difficult. Working hard at the recycling site, Nishide talked about the future vision.

"At present, the main business of NIRE is ore refinement. We will increase the production volume through two specific measures. One is to simplify the process and create an environment where employees can work easily and promote equipment maintenance activity in order to eliminate error and trouble in the existing recycling system. The other is to develop new scrap processing technology and introduce new equipment. The environmental impact of the ore refinement business is high because waste is generated in the refining process. The recycling business is environmentally friendly and therefore has a significant advantage. It contributes to the stable supply of raw materials. We must promote the business because sustainability has become increasingly important. I hope to develop the recycling business into the core business of NIRE," said Nishide.

Niagara Refining LLC Vice President Naohiro Toda

Toward a future where tungsten is recycled 100%

Recycling system developed by Toyota and Sumitomo Electric

Tips of cemented carbide tools collected from Toyota's plants

Removing the procurement risk of materials by promoting recycling

Various tools made from rare metals

In 2013, there was a landmark event as a result of tungsten recycling promoted by the Sumitomo Electric Group. The recycling system for cemented carbide tools in Japan, which was established through collaboration between Sumitomo Electric and Toyota Motor Corporation, which is the user of the tools, was recognized with the Rare Metal Recycling Award in the Awards for Resources Recirculation Technologies and Systems, under the auspices of the Japan Environmental Management Association for Industry. Cemented carbide tools are considered a source of competitiveness for Japanese automakers, including Toyota. Their stable quality and price have underpinned the auto industry. However, tungsten, a raw material of cemented carbide tools, is difficult to substitute with other substances. Dependence on imports also posed a risk for automakers as users of such tools. Ayami Imakiire, who was mainly in charge of the procurement of cemented carbide tools at Toyota, was quite concerned about securing materials. At that time, the Sumitomo Electric Group made a proposal to build a recycling mechanism together.

"The Sumitomo Electric Group is one of our main suppliers. We received a proposal from a person in charge to collaborate in recycling around 2011. We learned that they had developed a new recycling technology (the abovementioned oxidation-wet chemical process) and that high-purity tungsten could be recovered from scrap by using the technology. It was a very interesting and attractive proposal. One of the issues faced by the Sumitomo Electric Group was that it could not collect a large amount of scrap. They thought that we could collect a certain amount of scrap. This developed into a project to build a recycling mechanism. Previously, we sold scrap, but we launched collaboration in recycling with the Sumitomo Electric Group with a view to significantly reducing the procurement risk of materials by recycling and contributing to the SDGs," said Imakiire.

Extensive sorting by Toyota

Toyota was quick to take action. The Materials & Facilities Purchasing Div. grasped the social circumstances and quickly identified the needs. It asked for cooperation from plants as well as the relevant departments, including the production engineering and environment departments, and launched company-wide efforts. However, recycling efforts do not produce results immediately. The division worked hard to spread awareness and win support from many employees.

"To build a recycling system, workers at the respective sites must work on sorting. We patiently explained the overall economic advantages and social mission of this activity to the relevant personnel in the company and won their support gradually," said Imakiire.

Notably, a sorting method was established with recycling in mind in collaboration with the Sumitomo Electric Group, which undertakes the post-process of recycling. Sorting was conducted properly at respective plants of Toyota: not just major classification of "cemented carbide tools" and "dies and molds," but also in-depth sorting of scrap, including cutting tips and drills (detailed classification of cemented carbide tools). Subsequently, the first recycling system in Japan was established on a commercial basis in collaboration with recycling companies, achieving 100% collection and recycling of tungsten from scrap of cemented carbide products.

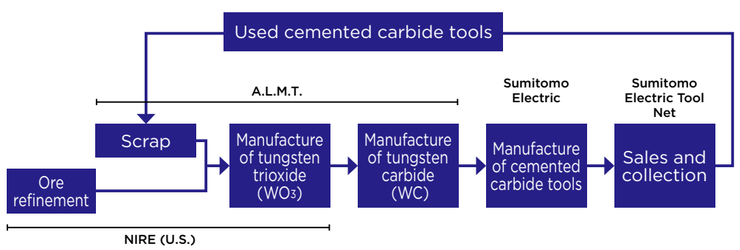
"At present, the recycling system is operating smoothly. The system has been well established. In the future, we hope to build a recycling mechanism not only for hard scrap but also for sludge. I hope that the Sumitomo Electric Group will improve its recycling technology, which can ensure the economy of rare metals and achieve the recycling of rare metals other than tungsten in Japan," said Imakiire.

The Sumitomo Electric Group is expected to expand its recycling business to meet Toyota's expectations.

Ayami Imakiire (second from right)
Unit Facilities Group, Facilities/Prototype Dept.,
Materials & Facilities Purchasing Div., Purchasing Group
Toyota Motor Corporation

With members

■ Tungsten recycling flow of the Sumitomo Electric Group



At the commendation ceremony, left to right: Yu Asano (General Manager, Environmental Affairs Div., Toyota), Shigeki Terashi (Director/ Senior Managing Officer, Toyota), Nozomi Ushijima (Managing Director, SEI), Akihiko Ikegaya (Managing Director, ALMT)

Evolution of recycling and a challenge to promote innovation

With the completion of the recycling system in Japan, achieved in collaboration with Toyota, the Sumitomo Electric Group's recycling efforts attracted considerable public attention. Tungsten recycling in Japan, including efforts made by the Sumitomo Electric Group, has been accelerating gradually. However, complete recycling has only partially been achieved. Under these circumstances, what action will the Sumitomo Electric Group take? Toshiyuki Sahashi, Managing Director of Sumitomo Electric and Deputy General Manager of the Advanced Materials Business Unit, stated as follows regarding the recycling business in the future:

"The development of the chemical process at A.L.M.T. and the establishment of NIRE in the U.S. have made it possible to handle the entire process from raw materials in the upstream (ore refinement and scrap) to cemented carbide tools, the final products. This is the strength of our group. Ore refinement poses many risks because it depends on overseas mines. Thus, it is necessary to promote the hard metal (cemented carbide) business with a focus on recycling. This requires technological perfection to achieve cost reduction while maintaining high quality. We must establish recycling technology quickly at NIRE and pursue higher technology at A.L.M.T. Given the uncertainty of the international situation, recycling is inevitably important. There are also risks from the viewpoint of business continuity planning (BCP). At present, we have only one company, located in Hokkaido, that manufactures cutting tips, which are the main products of cemented carbide tools. We would suffer tremendous damage if this company were to become inoperable due to a disaster. I was stationed at Sumitomo Electric Carbide, Inc., which invested in NIRE, as an expatriate when NIRE was established, so I have a strong commitment to NIRE's business. Now that NIRE is in place, a production system encompassing the production of tungsten trioxide (WO_3), tungsten carbide (WC), and the final products should be built in a different cycle. This is my future vision," said Sahashi.

It has been 10 years since the Sumitomo Electric Group developed the oxidation-wet chemical process as a new technology and started the recycling business. While the Group has steadily worked on the recycling of tungsten, the business environment and people's awareness of recycling have changed significantly. Namely, there has been a paradigm shift from "recycling is good" to "recycling is necessary." With the spread of the SDGs, many people have become aware of the importance of recycling and have started to take action in their daily lives. Under these circumstances, the Sumitomo Electric Group has produced significant results by developing an innovative recycling technology and building a mechanism to a certain extent in order to secure tungsten, one of the scarce resources. Efforts are being made on an ongoing basis. To seek a next-generation recycling model, the Sumitomo Electric Group has embarked on a new challenge toward further evolution and innovation.

Toshiyuki Sahashi
Managing Director, Deputy General Manager
of the Advanced Materials Business Unit

See the world from various viewpoints

Mission of the intellectual property staff: "Think based on the heliocentric model"

"Change your perspective, and you will see developments in our society, including changes in our business environment, changes in technologies, and the industrial policy of the national government. With such developments in mind, I want to contribute to the continuous development of our business by promoting intellectual property strategy in coordination with the business strategy."

id
Featured person

Hiroaki Sano
General Manager, Intellectual Property Dept.

April 1984	Joined Sumitomo Electric Industries, Ltd.
July 1984	Assigned to the Yokohama Research Laboratories (currently Optical Communication R&D Laboratories)
	In charge of optical fiber coating materials and drawing process development
July 1997	Transferred to the Intellectual Property Dept.
	In charge of making applications and establishing patent rights, holding licensing negotiations, and following litigation processes in the field of optical communication
March 2006	General Manager, Optical Material Applications R&D Department, Optical Communication R&D Laboratories
	In charge of the development of products by applying optical fibers and optical fiber technologies
April 2009	General Manager, Planning Department, R&D General Planning Division, and Director of the NEXT Group
	In charge of evaluating company-wide research topics and supporting businesses, and searching new topics
April 2012	General Manager, Intellectual Property Dept.
(Outside the company)	
2016 to 2017	Managing Director, Japan Intellectual Property Association (JIPA)
2018 to 2020	Vice President, JIPA
2012 to 2016	Director, Osaka Institute of Invention and Innovation
2017 to present	Executive Director, Osaka Institute of Invention and Innovation

A major turning point in optical fiber technology

After joining Sumitomo Electric, I was assigned to the Yokohama Research Laboratories (currently the Optical Communication R&D Laboratories). I was engaged in research on optical fibers. I majored in polymer chemistry at university and graduate school. I must admit I was anxious because I did not have any knowledge about optics and communication. However, times were changing in my favor. At that time, optical fiber coating technology was undergoing significant change. The shift from conventional thermosetting resins to UV-curing resins offered me an opportunity to take advantage of my knowledge of polymer synthesis. Optical fibers are manufactured by combining various technologies. Thus, I was assigned to the development of materials and processes as an expert of UV-curing resins in the first year of my career. In the development of the drawing process for UV-curing resins, I experienced the joy of research because the results were being produced steadily. For example, the manufacturing speed of 50 m/min. was improved to 1,300 m/min. (on an experimental basis). Subsequently, I conducted research on optical cables and construction methods. I was engaged in the development of fundamental technologies for optical communication lines, which are currently in use. When I worked as a researcher, I was engaged in intellectual property (IP), which is my current field, as an engineer engaged in patent licensing to competitors and activities for technology competitions organized by customers. After gaining experience through these activities, I was transferred to the Intellectual Property Dept. in 1997 to handle patent disputes in the optical communication field.

Predominance in the market achieved by patents

Construction of the optical fiber network in Japan was expected to be almost completed in the latter half of the 1990s. This would make our optical fiber business in Japan difficult. Thus, we studied the possibility of deploying our business in overseas markets. One of the target countries was the U.S., where Corning Incorporated was headquartered. At the end of the 1980s, we lost a patent lawsuit filed by Corning, the largest optical fiber manufacturer in the world, causing our ambitions to enter the U.S. market to fail. Throughout the 1990s, many researchers in the optical communication field at Sumitomo Electric worked on efforts related to IP in order to fully launch into the U.S. market and contribute to the world with our technologies. We scrutinized and conducted research on the technologies of our competitors, including Corning, to find out what patents we should acquire to counter our competitors. After a long preparation period, we filed a lawsuit against Corning on patent infringement in September 2000. We worked with the relevant business divisions, research division, and legal department to visit the U.S., held negotiations with Corning, and produced satisfactory results. These efforts turned out to be highly effective in ensuring our business flexibility by using patent rights. In the market, only IP rights, including patents, can directly restrict competitors' business. We also concluded many contracts, including cross licensing, with our competitors in Europe and Japan, removing constraints on our global business operations. The patent lawsuit on optical fibers and subsequent negotiations reminded us that the IP rights could change the market environment to our advantage. I became keenly aware of the importance of formulating and implementing the business strategy and IP strategy in a coordinated manner.

I returned to the R&D Group in 2006 to take charge of the technology development of optical fibers. I was then transferred to the R&D General Planning Division to manage the budget and progress of company-wide research topics. This provided me an opportunity to learn various technologies and business models of Sumitomo Electric, including the engineering capabilities, manufacturing sites, and business divisions across the company. This experience turned out to be highly useful in my career in terms of IP.

IP for prevailing in business

I have served as General Manager of the Intellectual Property Dept. since 2012. From the 1990s to 2000s, many Japanese manufacturing companies, including Sumitomo Electric, made a big mistake in their IP strategy in China and other emerging markets. During this period, Sumitomo Electric's competitors were other Japanese companies or European and American companies. While competing in technology development, Sumitomo Electric made many patent applications in Japan, Europe, and the U.S. This became a major factor behind technology leakage from Japanese companies to new companies in emerging markets, including China. At that time, Japanese companies focused on technology development and expanded business by using technologies, such as the quality and functionality of their products, as strengths. Since the 2010s, it has become difficult to make a difference based solely on engineering capabilities. Today, the largest customer segment in the global market is the emerging economies. The balance between quality and cost must be acceptable to the market. The operations of the IP department must change in response to changes in the business environment. To achieve continuous business development, it is indispensable to manage trade secrets to protect our inventions, take advantage of exclusive licenses (namely, patent rights), which can be obtained on the condition that trade secrets are disclosed, and ensure technology standardization to share technologies, thereby achieving the predominance of our products in the market and users' convenience, in close coordination with the business strategy. With this in mind, I have worked on IP for about 10 years. The IP activity, which previously sought to increase the number of applications, has been shifting to quality-oriented strategic applications in anticipation of using rights. In addition, management of trade secrets and standardization have been regarded as part of the IP activity to expand the scope of the IP activity. Recently, I have been increasingly asked for advice and support for the deployment of overseas operations and standardization activity from respective business divisions. Efforts have been made to strengthen the activity from the viewpoint of IP.

Optical cable construction technology, in which Sano was engaged as a researcher, won the Japan Society for the Promotion of Machine Industry (JSPMI) Chairman's Award in 1993.

In the IP strategy, it is essential to change the perspective. Sumitomo Electric has responded to the detailed needs of customers and offered the best possible products to customers. It is important to conjecture the developments in the market and the competitive environment based on information available from customers. Now that international relations and the industrial structure are changing dramatically, it is necessary to pay attention to social changes in a broader scope, overlook many factors that affect the market, and adopt various viewpoints. Metaphorically, we must think based on the heliocentric model. Companies tend to assume the geocentric model, believing that they are the center of the universe. Our planet is rotating and revolving. Likewise, our society is changing in its own way. We must be more outward-looking than inward-looking. It is important to recognize and monitor the developments. This is applicable not only to IP-related personnel but also to many business persons. In the future, I want to focus on the development of human resources. The goal of all business persons, including IP-related personnel, is to make efforts so that their companies win in business. I hope to instill the mindset that each business person must fulfill his or her tasks to attain the goal. I will impart all the knowledge I have acquired to those who need it. Sumitomo Electric has various unique technologies and businesses. To generate revenue from such technologies and businesses and promote the continuous development of the company, it is useful to think about business strategy from the IP perspective. I hope that young people will observe developments in our society from a long-term perspective and come up with a business strategy for the next generation from various approaches, including IP.

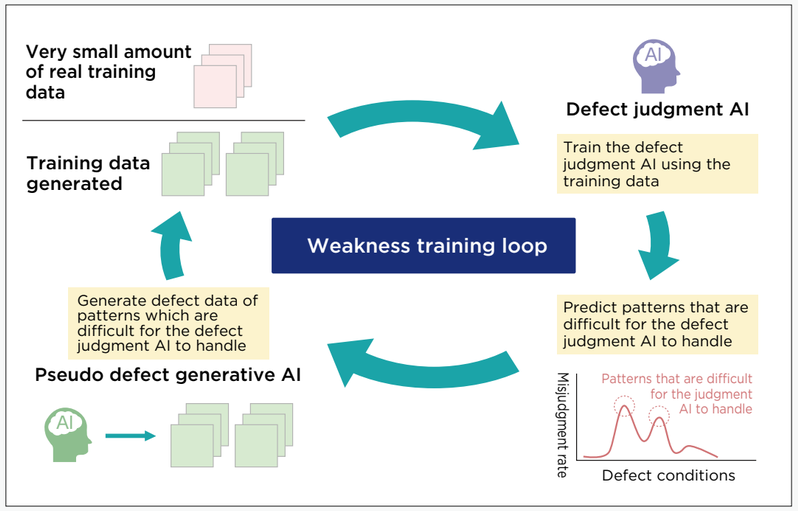
Sumitomo Electric Launches Technology Development on AI-based Defect Detection of Products with DATAGRID Inc.

– Promoting digital transformation at manufacturing sites to strengthen manufacturing –

At Sumitomo Electric, the IoT R&D Center (established in 2017) has taken the initiative to improve productivity and safety using IoT/AI technology toward promoting digital transformation at manufacturing sites. As part of such efforts, the company has been working on the development of defect detection AI to automate the appearance inspection of products conducted by skilled workers. However, to train the defect detection AI to attain advanced detection capabilities, it is necessary to prepare a large amount of training data that covers various patterns. Collection of training data requires considerable time and cost. This is why the defect detection AI has not been fully utilized by manufacturers, including Sumitomo Electric.

This project aims to develop AI capable of defect detection comparable to that of skilled workers even if only a very small amount of real training data is available.

Sumitomo Electric's defect detection technology is used to predict patterns that are difficult for the AI to handle and cause misdetection, and DATAGRID's pseudo-defect generative technology is used to generate defect data that are difficult for the AI to handle. The project also aims to overcome difficult patterns by repeatedly applying the technology to overcome difficulties by training (anti-weakness training loop), in which the defect detection AI is retrained using data generated, and thereby increase the accuracy of the defect detection AI.



QUARTERLY id

Q What is noteworthy about this joint technology development project?

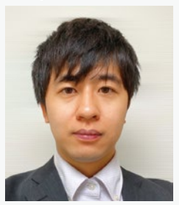
The technology to achieve coordinated training of the defect detection AI and the pseudo-defect generative AI has not been established. This would be the world's first such technology if we could develop it.

Students take mock examinations to identify their weak subjects and intensively study those subjects to efficiently increase their scores. Likewise, this technology is expected to increase the development speed of the defect detection AI by tens or hundreds of times by allowing a computer to repeat the anti-weakness training loop automatically. The technology to overcome difficulties through training is also effective for various data, including time series data, in addition to image data. It can be applied to various processes at manufacturing sites, such as automation of the appearance inspection process, failure prediction of equipment, and inventory control. Thus, the technology is expected to accelerate automation at manufacturing sites. We will take advantage of these technologies to improve the manufacturing capabilities.

AI Promotion Department, IoT R&D Center

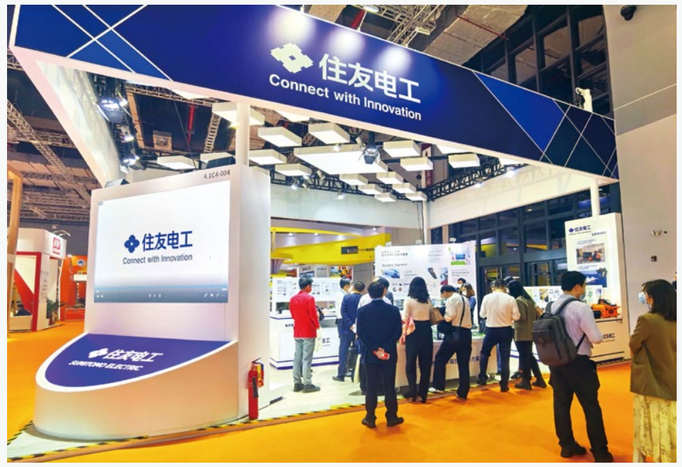
Shun Yoshida

Shoya Ishida



Sumitomo Electric Exhibits at CIIE, One of the Largest Exhibitions in China

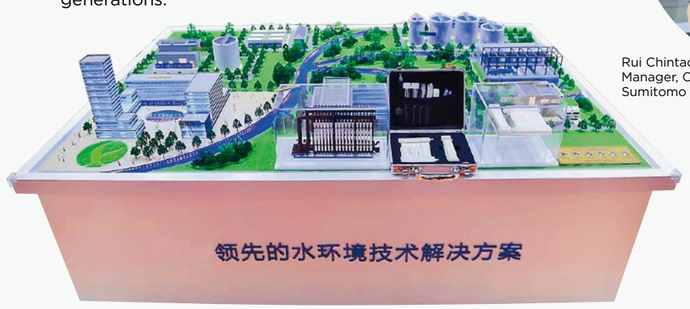
China International Import Expo (CIIE) was held in Shanghai from November 5, 2021. About 2,900 companies from 127 countries and regions exhibited at this large-scale exhibition. Sumitomo Electric exhibited its products and technologies from relevant business fields, including automotive, infocommunications, electronics, and industrial materials, on the theme of "Technology for a Better Tomorrow," and introduced applications in China. This article features some of the products that attracted attention.



[Water treatment membrane modules]

Sumitomo Electric's water treatment membrane modules incorporate membranes characterized by excellent chemical and thermal resistance and durability. The biggest advantage is the capability to treat industrial water and wastewater, such as domestic water, in an energy-efficient manner. We started to sell the products in China more than 10 years ago. The modules have been introduced to more than 1,000 projects. At this exhibition, we exhibited a diorama to present its wastewater treatment technology built into urban development in China, and demonstrated its products and technologies to help attain the "double carbon" goals advocated by the Chinese government. Our reliable technologies help pass on precious water resources and a rich natural environment to future generations.

Eiji Sakai
President, Sumitomo Electric Trading (Shenzhen) Co., Ltd.



A diorama to present Sumitomo Electric's wastewater treatment technology built into urban development

[Fusion splicers for submarine optical cables]

We unveiled the only fusion splicer in the world, which can be used for submarine optical cables, in China. Once constructed, submarine cables are used for more than 20 years. Thus, fusion splicers are required ensure high quality and reliability. Sumitomo Electric started to develop fusion splicers more than 20 years ago. Various fusion splicers, including this product, which meet market needs by utilizing technologies that have been refined through many years of operations, attracted the attention of visitors.

Rui Chintao
Manager, Optical Communication Sales Dept.
Sumitomo Electric Trading (Shenzhen) Co., Ltd.

Sumitomo Electric's world-renowned fusion splicer

Sumitomo Electric Asia, Ltd.
Managing Director, Nobuhiro Kuwata

Sumitomo Electric started to deploy its business in China in the 1980s. Today, the group consists of about 100 companies with about 40,000 employees engaged in business operations. At this exhibition, we exhibited various products in addition to the above products, including component parts for automotive harnesses (connectors and sub-harnesses), high-speed transmission/in-vehicle flexible flat cables (FFCs), in-vehicle/medical cables, cutting tools, and soft magnetic powder cores for axial gap motors. These are important products indispensable for the development of automobiles and electronics. The Sumitomo Electric Group remains committed to R&D on products that meet market needs and contribute to realizing a better society by using its connectivity and communications technologies.

A Picture of Sumitomo Electric in Those Days

1993

First traffic control system outside Japan built in Thailand

Multifunctional signboard of an expressway traffic control system

Contribution to improving the traffic network in Thailand, a fast-growing emerging country

In June 1993, Sumitomo Electric completed the traffic control system for the Second Stage Expressway in Bangkok, Thailand.

This expressway was planned to eliminate chronic traffic congestion. The elevated expressway spanning 20 km connects Bangkok with the international airport in the suburbs. Sumitomo Electric was awarded a contract for a traffic control system and built a multifunctional display system for providing road information, a road condition monitoring system using CCTV cameras, an emergency communication network based on an emergency call system, and a radio communication system for highway patrols.

It was the first time for Sumitomo Electric to introduce a full-scale traffic control system outside Japan. This was an unprecedented project for the company to connect the equipment for a traffic control system manufactured by Sumitomo Electric with equipment procured outside Japan (such as emergency call equipment), and locally develop part of the software. It was difficult to manage the delivery time of the equipment procured outside Japan. Nevertheless, the construction was successfully completed in 23 months, the construction period stipulated in the contract. In 1995 and 1998, the system was expanded to cover an extension route of the expressway. Construction was completed ahead of schedule in response to a request to complete it before the 13th Asian Games (Bangkok 1998). Sumitomo Electric contributed to improving the traffic network in Thailand where construction of the expressway continues.

· Also refer to “Tackling Urban Problems,” the feature in vol. 08 of id.
https://global-sei.com/id/2019/05/pdf/sei_id008.pdf

id vol.17

Information and videos not posted in this magazine are found on the "id" special site
https://global-sei.com/id/

Issue: Spring 2022
Publisher: Sumitomo Electric Industries, Ltd.
(Public Relations Department)
4-5-33, Kitahama, Chuo-ku, Osaka, Japan
Publisher in charge: Miwa Kunii
Editor: Universal Combo Inc.