

Featured Topic: Expectations for R&D for Increasingly Diverse and High-Functionality Industrial Materials

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1. Sumitomo Electric's Industrial Materials Business Commenced in the 1920s, in a More Difficult Era than Now

Since January 2020, we have seen the spread of the novel pneumonia caused by the novel coronavirus. Comparisons of the disease with the Spanish flu epidemic, which took place a century ago, has been on everybody's lips. The 1918 influenza pandemic is said to have led to more than 40 million deaths, accounting for 2% of the then world population of two billion. Although it is known as the Spanish flu, it is said that the source of infection was U.S. soldiers entering World War I bringing the disease from the United States to Europe. In the first-ever world war, many people, including soldiers, moved and came into contact with other people on a global scale. Probably due to this, infectious diseases could spread very quickly. It is said that the death toll of World War I was 15 million in total, including both military personnel and civilians. Consequently, the number of victims of the Spanish flu was far greater than those of World War I. The world then faced truly difficult times.

Let's get closer to the subject. A century ago in World War I, Japan joined the Allied Powers and opposed Germany. This probably had a substantial influence on the Japanese industrial sector. Only a half-century after the Meiji Restoration, Japan at the time depended on imports from Western countries, including Germany, for procurement of machine tools and other machinery and equipment as well as special steel and other materials.

The war broke the supply chain for various equipment, materials, and parts from Germany, which must have been a devastating blow to Japanese industry. However, the Japanese people at the time had formidable vitality. To recover from this setback, they began domestic production of tools and machine tools. Beginning with repairing machine tools or resharpening tools, many companies emerged in those days as special steel, machine tool, and tool manufacturers. It was often the case that engineers and artisans who had worked at a naval or army arsenal became

independent and started their own businesses.

Defeated in World War I, Germany experienced a drastic fall in its national power due to post-war hyperinflation and political and social confusion. Its sense of hostility toward former enemies including Japan is known to have continued through the 1920s and thereafter. In such an environment, Sumitomo Electric Industries, Ltd. set up a core business in its industrial materials division. It is highly probable that the above-described international relations and social circumstances had a direct or indirect impact on the establishment of the core business.

Now let's get to the subject at hand. First, regarding special steel wires, Sumitomo Electric began researching them in 1927. Until then, Japan had depended on imports from Sweden and Germany for most special steel wires. Sumitomo Electric's research and development efforts were a response to the strong need to eliminate this dependence. The inauguration of a company-wide research division in 1930 spurred this research. In 1932, Sumitomo Electric commercialized special steel wires made of an iron-nickel-copper alloy and began selling them to Sumitomo Chemical Co., Ltd. The wires were used in filters to separate ammonium sulfate crystals for fertilizers. Subsequently, in the 1930s, Sumitomo Electric successfully instigated domestic production of stainless steel wire and piano wire for valve springs used in naval aircraft.

Next, let's look at powder metallurgy. In 1923, German Osram Studiengesellschaft, a light bulb manufacturer, invented and patented cemented carbide as a composite material using tungsten carbide (WC) as the hard phase and cobalt (Co) as the binder. Subsequently, cemented carbide rapidly proliferated in Europe as a material for wear-resistant and cutting tools. Sumitomo Electric was closely watching technology development trends in Europe. Coming up with the idea that cemented carbide, if applied to drawing dies for electric materials, could be a solution to the issue of short-lived dies due to rapid wear, Sumitomo Electric formed a project team in 1927, which pursued research and development for in-house production

of cemented carbide. The Company had success in developing cemented carbide dies as early as 1928, which provided a clue to solving the challenge of speeding up wire drawing equipment.

Furthermore, in 1931, Sumitomo Electric placed turning tools on the market under the brand name Igetalloy, which was the beginning of the Company's powder metallurgy business. Whether the product was a special steel wire or a powder metallurgical products, the people at Sumitomo Electric at the time created and commercialized new products one after another within five to ten years after they started their research. Their efforts and abilities to materialize their ideas were truly worthy of respect. The Company subsequently expanded its special steel wire business, commercializing products such as prestressing (PC) steel wires indispensable to bridges and other infrastructure construction, and steel tire cords. Meanwhile, the powder metallurgy business has diversified into the sintered alloy products business and A.L.M.T. Corporation's business. The former specializes in the manufacture and sales of structural parts for use in automobiles and home appliances, by press-molding and sintering iron and aluminum powders. The latter manufactures and sells diamond products and heatspreaders by molding and sintering powdered tungsten or molybdenum blended with powdered copper or other constituents.

2. Industrial Materials Depending on the Automotive Sector and Adapting to Connected, Autonomous, Shared, and Electric/Electrified (CASE) Vehicles

Sumitomo Electric's industrial materials business grew from primarily fulfilling military demand in the wartime period to responding to postwar demand in the automotive, steel, industrial machinery, infrastructure, and medical care sectors. The automotive sector is a core industry. The Company's industrial materials destined for the automotive sector account for a very large part of its overall industrial materials. At a closer look, however, individual business segments have substantially different levels of dependence. The special steel wire business centers around PC steel wires used for the construction of bridges and other infrastructure projects. Automotive products such as engine valve springs and steel tire cords are also important, with sales dependence on the automotive sector being estimated at 40%. Among powder metallurgy business segments, the cutting tool business depends on the automotive sector at a proportion estimated at 50%. The proportion rises to 95% for sintered alloy products primarily offering iron and aluminum-based parts, while it is approximately 30% for A.L.M.T., which deals with diverse items ranging from tungsten and molybdenum products to heat-spreaders and diamond products.

Sintered alloy parts depend greatly on the automotive sector. Notably, engine and transmission parts account for 60% of overall sales. If, in the CASE trend, electric vehicles (EVs), which have no engine or transmission, become prevalent, the sintered alloy business will be on the verge

of extinction. Sumitomo Electric is therefore involved in research and development with the aim of shifting the business so that it is more in line with the trend toward EVs. Examples include soft magnetic powder composites for motors, applications of which include EVs, axial gap motors constructed to Sumitomo Electric's proprietary design, and sintered alloy gears contained in EV gearboxes. In addition, the Company has begun fortifying the marketing of non-automotive parts produced through the application of green machining and other techniques.

Meanwhile, in fact, the trend toward EVs has not progressed so rapidly even though the media reported on this trend enthusiastically two or three years ago. The rate-determining factors are not limited to restricted battery ranges and longer recharging times than refueling times for gasoline vehicles. The slowing factors include the following:

- The batteries use large amounts of precious minor metals such as lithium and cobalt, making EVs not so eco-friendly. Moreover, the risk of procurement failure is present for minor metals.
- Use of electricity generated by conventional thermal power plants to recharge batteries does not lead to a significant reduction in CO₂ emissions.
- EVs use a large number and variety of wiring harnesses, which significantly increases copper consumption.
- Repeated short quick recharging consumes an even larger amount of electricity.
- It is unclear who will provide the recharging infrastructure. Existing gas stations are unable to fund the required cost.

Nonetheless, if wind, solar, and other renewable energy sources grow rapidly, such as through tighter environmental regulations, the scenario may change, possibly resulting in an accelerated trend toward EVs. If we assume that EVs will account for 10% of the overall automotive sector, which will amount to ¥300 trillion in 2030, it then becomes important to make Sumitomo Electric's industrial materials business even more ready for EVs with the aim of expanding its business to cater for a ¥30 trillion industry.

Meanwhile, if the trend is toward electrified, which includes HEVs and PHEVs, it becomes important to intensify and expand the development of diverse HEV- and PHEV-related parts, including sintered parts, and processing methods for them. Regarding the connected (C) and autonomous (A) of CASE, demand is forecast to grow for electronic parts. Accordingly, demand is forecast to grow for powder metallurgy tools and heatspreader products of A.L.M.T. Due to a substantial increase in the number of parts in connected, autonomous, and electrified vehicles, it is necessary to constantly aim for weight reduction and downsizing of discrete parts. The use of lightweight but difficult-to-cut materials is expected to expand, including magnesium and ceramic matrix composites (CMCs), as well as aluminum.

Regarding autonomous, personally, I am acutely

aware of the need for measures to counter the emerging social issue of elderly drivers. I have also aged and have huge expectations for improved self-driving systems designed to support safe driving to protect the lives of elderly drivers and the people around them. The trend for shared (S) is said to have slowed sharply due to the recent confusion relating to the coronavirus pandemic, with people being urged to avoid coming into contact with others and riding together, although what trend will develop in the future is unknown.

3. Hopes on Breakthrough Technologies and Products toward the 100th Anniversary of Sumitomo Electric's Industrial Materials Business

Both special steel wire and powder metallurgy business segments of Sumitomo Electric began research and development efforts in 1927, and they will celebrate their 100th anniversary six years from now. The Industrial Materials Group should achieve positive research and development results for the coming several years in line with the common directions stated below, which are applicable throughout the group.

- Adapt automotive products to CASE; expand the business with both electric and electrified vehicles in mind.
- Yet lower the dependence on the automotive sector and ensure diverse sources of profits, taking lessons from the first quarter last year.
- Contribute even more to green products, eco-friendliness, and energy conservation.

In the special steel wire business, efforts should be directed toward strengthening and expanding the infrastructure-related business, which proudly specializes in PC steel wires. More specifically, optical fiber-embedded PC strands, high-strength steel fiber, and high-strength electric wires made of composite materials of steel, copper, and other materials should be commercialized.

In the hardmetal business, sensing tools should be commercialized to create new value, ensuring the prevention of tool breakage problems at customers and improved productivity made possible through improved preset tool life. Development efforts for innovative materials and products should be enhanced even more for business expansion in the aircraft and medical care segments new to Sumitomo Electric.

In the sintered alloy products business, it is encouraged to create a novel business using green machining, along with sintering and forging techniques for producing profitable axial gap motor cores and high-strength gears, and to look for business opportunities in non-automotive segments.

A.L.M.T. is expected to make further efforts towards adapting its in-vehicle items to CASE by developing novel heatspreader materials and technologies, which will also

create sources of profits exceeding ¥100 million per month as successors to the G-Cutter in the categories of medical care products and extreme ultraviolet (EUV) applications.

Through these efforts, the foundation of the Industrial Materials Group should be strengthened for it to continue to thrive beyond its 100th anniversary.

- Igetalloy is a trademark or registered trademark of Sumitomo Electric Industries, Ltd.