

# JAPAN FINE CERAMICS ASSOCIATION AND ITS INTERNATIONAL STANDARDIZATION ACTIVITIES FOR FINE CERAMICS

By Hirofumi Takemura

Japan Fine Ceramics Association (JFCA) was established in 1986 with a mission to promote the development of the fine ceramics/advanced ceramics industry. To take advantage of the most advanced technologies of fine ceramics, overall collaboration of manufacturers, users, universities, and research laboratories is required, together with the fusion of other materials.

The members of JFCA are 104 companies from different industries, such as ceramics, chemicals, metals, automobiles, electronics, power supply, and service. Through various activities, JFCA brings together and promotes cooperation among government, industry, academia, and overseas countries for the further expansion of the fine ceramics industry. The United States Advanced Ceramics Association (USACA), European Ceramics Center (PEC), and Ceramics Application are cooperating members of JFCA.

There are technical committees and consortiums in JFCA. Committees operate research groups such as Solid Oxide Fuel Cells, Power Electronics, GaN, LED, Bioceramics, Optical Ceramics, Material Function Predictive Simulation, Advanced Coating Alliance, and Ceramics Matrix

Composites Consortium. In September, Fine Ceramics Roadmap 2050 Study Group was launched, which will publish the latest Roadmap in both Japanese and English versions in December 2021.

Figure 1 shows the amount of fine ceramics production in Japan, which reached \$30 billion in 2018.<sup>1</sup>

The benefits of standards for worldwide industries are extensive.<sup>2</sup> Standards help manufacturers reduce costs, anticipate technical requirements, and increase productive and innovative efficiency. Standards make trade across international borders easier and promote global competition, having a positive impact on economies.

Standards provide consumers with confidence in the quality and safety of products and services. In a global economy of rapidly emerging new technologies and markets, standards help set the rules and establish the frameworks, making it easier to innovate successfully.

ISO international standards help businesses of any size and sector reduce costs, increase productivity, and access new markets. Standards can help to

- Build customer confidence that the products are safe and reliable;
- Meet regulation requirements, at a lower cost;
- Reduce costs across all aspects of a business;
- Gain market access across the world;
- Improve quality, safety, and lead time of products and services;
- Lower research and development costs and improve speed to market by building on previously standardized technology or systems; and
- Provide uniformity of units measurement, enabling accuracy and confidence in commercial transactions locally and globally.

## THE ROLE OF JFCA

JFCA conducts surveys and research to promote the international standardization of fine ceramics. JFCA, as a drafting organization in

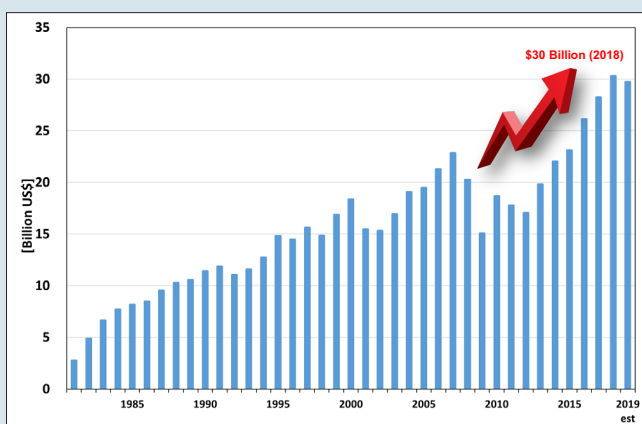


Figure 1. Fine ceramics production in Japan.  
Credit: Japan Fine Ceramics Association

the field of fine ceramics, is making international standards for high-quality, safe, secure, and highly reliable fine ceramic materials.

JFCA holds the secretariat of ISO/TC206 (Fine Ceramics) and ISO/TC150/SC7 (Tissue-engineered Medical Products) under the Japanese Industrial Standards Committee. In addition, as a national committee for ISO/TC206 and ISO/TC150 (Implants for Surgery) in Japan, we are engaged in deliberating proposals for new work items, development of projects in Japan and other countries, and maintenance and management of issued ISO standards.

### ACCELERATION OF STANDARDIZATION SPEED

The speed of technological development increases to popularize new technologies globally. The conventional model shown in Figure 2, "Research & Development-Standard Development-Manufacturing / Products," cannot catch up with its speed.

It is necessary to proceed with R&D and standard development at the same time and connect it to global manufacturing.

As shown in Figure 3, loop-shaped parallel development becomes the most effective way to establish standardization.<sup>3</sup>

### ABOUT INTERNATIONAL STANDARDS ORGANIZATION

International standards are published by international standardization bodies; three organizations are the representative. International Organization for Standardization (ISO) establishes international standards in a wide range of fields, except the fields of electricity, electronics, and communications. International Electrotechnical Commission (IEC) establishes international standards in the fields of electricity and electronics, and International Telecommunication Union (ITU) establishes international standards in the fields of communication, broadcasting, and information technology.

ISO is currently divided into 333 technical committees that deliberate and manage international standardization. The international standards for fine ceramic materials mainly belong to two committees: ISO/TC206 (Fine Ceramics) and ISO/TC150 (Implants for Surgery).

ISO/TC206 standardizes various forms and functions of fine ceramics. Japan is the secretariat of this committee and has a committee manager. The chair is from South Korea. The ISO/TC206 scope states as follows<sup>4</sup>: Standardization in the field of fine ceramics materials and products in all forms: powders, monoliths, coatings and composites, intended for specific functional applications including mechanical, thermal, chemical, electrical, magnetic, optical, and combinations thereof. The term "fine ceramics" is defined as "a highly engineered, high performance, predominantly non-metallic, inorganic material having specific functional attributes."

#### Conventional: Progress in stages



Figure 2. Conventional standardization model. Credit: Japan Fine Ceramics Association

#### Future: Progress in parallel

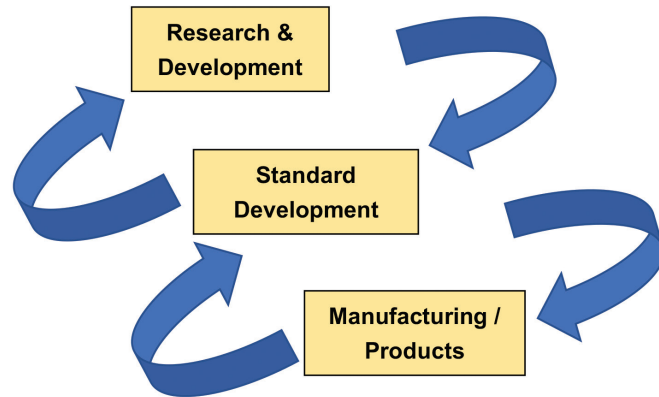


Figure 3. Future standardization model. Credit: Japan Fine Ceramics Association

Note: Alternative terms for fine ceramics are advanced ceramics, engineered ceramics, technical ceramics, or high-performance ceramics.

The ISO/TC206 strategic business plan has the following description<sup>4</sup>:

World demand for fine ceramics is projected to expand to \$75 billion in the year 2020.

In order for the fine ceramics industry to further grow to contribute to the 21<sup>st</sup> century as a new materials industry, the following issues have to be overcome.

- Further promotion of research and development in terms of the material itself, development of new uses and application technologies.
- Research on manufacturing processes, and cost-reduction through corporate efforts.
- Establishment of testing and evaluation methods and standardization of the methods to prepare a basis for research and development, application, and utilization.
- Promoting international cooperation in the fields of research and development, and standardization.

Table 1 shows the composition of ISO/TC206, the number of ISO registrations, and the number under development. ISO/TC206 is divided into more specialized working groups (WGs) from WG1 to WG12. Since the committee's inception in 1992, 136 standards have been issued. In recent years, about 10 new standards were published each year. In addition, there are 18 items under development.

WG	Title	Published Standards	Standards under development
WG1	Terminology/Classification	2	1
WG2	Powders	16	0
WG3	Chemical analysis	4	3
WG4	Composites	22	2
WG5	Porous ceramics	4	0
WG6	Monolithic ceramics/Mechanical properties	20	0
WG7	Monolithic ceramics/Physical and thermal properties	10	1
WG8	Joining	4	0
WG9	Photocatalysis	28	3
WG10	Coatings	16	2
WG11	Electrical and optical applications	6	3
WG12	Engineering applications	4	3
ISO/TC206		136	18

**Table 1.** ISO / TC206 structure, number of published standards and standards under development

SC/WG	Title	Published Standards	Standards under development
SC1	Materials	37	7
SC2	Cardiovascular implants and extracorporeal systems	33	11
SC4	Bone and joint replacements	36	5
SC5	Osteosynthesis and spinal devices	26	9
SC6	Active implants	16	2
SC7	Tissue-engineered medical products	4	0
WG1-15		14	5
ISO/TC150		166	39

**Table 2.** ISO/TC150 structure, number of published standards and standards under development

New work-item proposals are deliberated by experts in the relevant working groups depending on the technical field. After approval of new business-item proposals, deliberation and approval proceed by passing through the stages of working draft, committee draft, draft international standard, and final draft international standard, to the goal of being published. It takes about three years to complete the process.

ISO/TC206 is currently composed of Participating Members from 14 countries (nine countries in Europe; five countries in Asia) and Observer Members from 20 countries. Participating Members have the right to vote and can elect experts to actively participate in the proposed project.

ISO/TC206 holds a plenary meeting once a year where member countries can participate. This year, it was scheduled to be held in Brussels, Belgium, but due to the COVID-19 pandemic, the face-to-face conference was canceled, and a web conference was held by Japan. The plenary meeting is a valuable opportunity for experts on global standardization to gather once a year, but it was a shame it was canceled. It is scheduled to be held in France in 2021 and in Belgium

in 2022. Japan took the role as host country in the first, tenth, and twentieth plenary meetings. 2023 will be the thirtieth meeting, and we would like to hold the meeting in Kyoto, Japan.

ISO/TC150 is a committee related to surgical implants. It includes bioceramics such as artificial bones and dental implants, which overlap with the field of fine ceramics. Germany is the chair of TC150, and Japan holds the secretariat of TC150/SC7.

The ISO/TC150 scope states as follows<sup>5</sup>:

Standardization in the field of implants for surgery and their required instrumentation, covering terminology, specifications, and methods of tests for all types of implants, and for the materials both basic and composite used in their manufacture and application.

The ISO/TC150 configuration is divided into specialized fields: subcommittee (SC) from SC1 to SC7, and working groups from WG1 to WG15. Since its inception in 1971, the technical committee has issued 166 standards, and 39 standards are under development.

ISO/TC150 currently consists of Participating Members from 29 countries, and Observer Members from 17 countries.

#### RECENT INTERNATIONAL STANDARDIZATION ACTIVITIES

New work-item proposals were made from Japan to ISO/TC206 in 2020. Two proposals were made regarding the thermal characteristics evaluation method for ceramic substrates for power modules, and one proposal was made regarding the evaluation method for power generation characteristics of piezoelectric materials. One new work-item proposal was approved for a ceramic substrate for a

power module, and it is currently at working draft stage.

The market size of power modules was 420 billion yen in 2019, and it is projected to be 570 billion yen in 2025 (140% of 2019). The core technology for ensuring the long-term reliability of power modules is the high-temperature resistance of power semiconductors. More specifically, it is heat that controls the change over time, and the ambient temperature and heat generated by driving the element contribute as heat sources.

We have strategically promoted the world's first international standardization of the method for measuring the thermal properties of ceramic substrates for power electronics, which is a key element of next-generation power semiconductors.

In addition, JFCA is promoting a research project to develop international standardization of fine ceramics as a preliminary step to propose new work-item proposals to ISO. We are working on about six projects a year. Each project takes three years to research, prepare a standardization draft, and make a new proposal to ISO.

The following projects are underway as ongoing research and research projects.

- Test method for GaN crystal surface defects.
- Strength reliability test method for ceramic materials for solid oxide fuel cells (SOFC).
- Corrosion-resistant test method for fine ceramic thin films.
- Optical characteristic evaluation method for ceramic phosphors for white LEDs.
- Test method for thermal characteristics of insulating substrates for power electronics.
- Mechanical property test method for bioceramics.

All of these projects cover advanced technological fields where the market for fine ceramic materials is expected to expand, and they are developments for standardization related to property test methods for fine ceramic materials. We are aiming for international standardization to ensure high-quality, safe, secure, and highly reliable fine ceramic materials.

To secure the competitiveness of the fine ceramics industry and to develop the industry, it is necessary to differentiate products by improving functionality, strengthen price competitiveness by innovation in manufacturing processes, enhance product revolution by innovation of materials, develop new markets, and lead with speed. We hope that the international standardization promoted by JFCA will contribute to the further expansion of the fine ceramics industry.

#### OTHER JFCA ACTIVITIES

**CMC International Cooperation:** CMC International Cooperation was established in 2020 for developing reliability assurance technology for ceramic matrix composites. This consortium consists of the CMC center at Tokyo University of Technology, Ultra High Temperature Materials Research Center, and JFCA.

CMC International initiated development of the international standard inspection method that can overcome the problems of the conventional test method for ceramic matrix composite reliability. The method of guaranteeing reliability for use by taking advantage of the "damage tolerance" is not established yet. The first step is to prepare SiC/SiC test pieces that are damaged and defective inside. Then, we will conduct an evaluation test (round robin test) using common test pieces by overseas joint research partners of the University of Birmingham and the University of California, Los Angeles.

**Giant Micro-photonics Research:** The Giant Micro-photonics Project was established in 2020 by RIKEN Spring-8 Center (RSC), National Institute for Materials Science (NIMS), Mitsubishi Electric Co., Kounoshima Chemical, and JFCA to achieve dramatic sophistication of extremely high-power, solid-state lasers and terahertz generation by new transparent ceramic materials, or so called giant micro-photonics.

Based on these research results, the project is expected to prototype and develop a compact ultrahigh output, power density laser and develop wavelength conversion technology, which was difficult until now. It is also designed to convert to other important wavelengths and apply laser driven particle accelerators.

**Japan Ceramics Expo:** JFCA is the coorganizer of Japan Ceramics Expo, which is one of the world's largest exhibitions alongside Ceramitec in Munich and Ceramics Expo in Cleveland, Ohio. Japan Ceramics Expo is organized by the Reed Exhibitions Japan and gathers all kinds of highly functional ceramics, materials, forming/processing equipment, burning/heating equipment, evaluation/testing/analysis equipment. It is held every year in Osaka and Tokyo.

Japan Ceramics Expo is chosen by advanced materials industry players worldwide as the best gateway to the Japanese and Asian markets. For more information, please go to

<https://www.ceramics-japan.jp/en-gb.html>.

#### Osaka Expo

Dates: Wednesday, June 23 to Friday, June 25, 2021

Venue: INTEX Osaka, Japan

#### Tokyo Expo

Dates: Wednesday, December 8 to Friday, December 10, 2021

Venue: Makuhari Messe, Japan

#### ABOUT THE AUTHOR

Hirofumi Takemura is director of Japan Fine Ceramics Association.

#### REFERENCES

<sup>1</sup>JFCA Fine Ceramics Industrial Trend Survey (2019)

<sup>2</sup>ISO-Benefits of standards (<https://www.iso.org/benefits-of-standards.html>)

<sup>3</sup>METI Standardization Seminar (2020)

<sup>4</sup>ISO/TC206-Fine ceramics (<https://www.iso.org/committee/54756.html>)

<sup>5</sup>ISO/TC150-Implants for surgery (<https://www.iso.org/committee/53058.html>)



Japan Ceramics Expo in 2018. Credit: Japan Fine Ceramics Association