

Preface to Special Issue “Science and Technology that Contributes to Society”

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(Received August 22, 2025)

1. Introduction

This special issue of Shimadzu Review commemorates Shimadzu Corporation’s 150th Anniversary. The issue reflects on the history of Shimadzu’s operations through the lens of research and development, summarizes prospects for future technological development in key areas, and presents articles describing specific examples of development in these areas.

Shimadzu’s journey through the last 150 years is covered by the commemorative website https://www.shimadzu.co.jp/150th_anniversary/ (August 22, 2025) and also touched upon in some parts of this special issue. Deferring to those sources, we will turn our attention to the Kyoto of 150 years ago, where Shimadzu was founded. In 794 AD, Emperor Kanmu founded Japan’s imperial capital of *Heian-kyō* (now Kyoto) as “An immediate expense, but a reward for future generations.” When the capital was relocated to Tokyo almost 1100 years later in 1869, it was undoubtedly a major shock to the city. That same year, Kyoto Governor Masanao Makimura announced broad policies for education and industrial development that led to the establishment of Kyoto’s Physics and Chemistry Research Institute (*Seimikyoku*, 1870), which was tasked to research physical sciences and promote chemical industry, the Industry and Commerce Promotion Office (*Kangyojo*, 1871), which served as a headquarters for promotion of industrial development, and a pharmaceutical affairs agency (*Shiyakujo*, 1875) that conducted lectures on chemistry and pharmaceutical sciences and undertook drug testing and certification.

Imagine an engineer in 19th-century Kyoto, hearing news of the world’s latest technological advances, and in the midst of the structural upheavals in Kyoto, establishing a company that will “contribute to society through science and technology.” This image of Shimadzu’s founder helps us imagine for a moment the world of 150 years ago, and picture cutting-edge technologies of the time that appear in textbooks today. Many cutting-edge technologies of the late 19th and early 20th centuries actually represent the

first emergence of advancements that continue to play an instrumental role in modern society. For example, chromatography was invented in 1903 by Mikhail Tsvet, a Russian biochemist, as a technique for separating plant pigments. Plant pigments were separated by Mikhail Tsvet based on differences in their velocity traveling through a medium. In physics, James Clerk Maxwell established the theory of electromagnetism in the 1860s and published “Maxwell’s equations” in 1864. Other events with a major impact on history were Alexander Graham Bell’s telephone experiments (1875) that established a new means of communication, and the Wright Flyer that made the first successful powered flight in 1903. How news of these inventions reached Kyoto is an interesting subject, but whether in the East or West, engineers of the time undoubtedly cut a similar figure when faced by this new technology, each inspired with a passionate aspiration to forge a nation shaped by science.

The contents of this special issue, outlined below, are presented in acknowledgment of the contributions made by the engineers who came before us, both within and outside Shimadzu. Prefaced by two special contributions, this special issue collects articles that outline future prospects in key areas where Shimadzu is committed to creating social value (life science, medical technology, green technology, materials, and industry), along with the results of ongoing research.

2. Special Contributions

The first of two special contributions in this special issue considers the impact of scientific publications produced by Shimadzu over the course of its 150-year history, both inside and outside the company. Looking through these publications, of which this special issue forms a part, and the research and accomplishments described therein, offers us a useful opportunity to consider how Shimadzu’s accomplishments are presented to the world, and provides context against which to consider future endeavors. The

second special contribution is a history of mass spectrometer technology and product development at Shimadzu. Mass spectrometer technology has undergone rapid advancement in recent years, and is an area that encompasses numerous technical elements, each requiring technological development. Mass spectrometer technology is a key area of focus for future research and development at Shimadzu. The article describes and explores mass spectrometry devices from their first practical uses to commercialization, as well as recent technological advancements and their wider adoption.

3. Life Sciences

This special issue provides an overview of the life science business, particularly work that innovates the drug discovery process. This includes Shimadzu's development of liquid chromatographs and AI analysis software tailored to an increasingly diverse range of drug discovery modalities, efforts to improve characterization analysis and quality assessment, and a wide range of supporting technologies used in cell therapy and regenerative medicine.

Also described are advancements and example applications in MS imaging-based enzyme histochemistry, tandem mass spectrometry (MS/MS) used for high-throughput structural analysis of lipid isomers with a novel ion dissociation method (OAD), and examples where automation technology has shaped research, development, and quality control for biopharmaceuticals.

4. Medical Technology (MedTech)

This special issue also summarizes technological innovation and future prospects in medical technology, includes a history of medical X-ray devices, Shimadzu's actions during the COVID-19 pandemic, contributions to clinical practice, and new challenges in medical technology.

A newly developed mobile digital radiography system is introduced. The mobile digital radiography system is designed to allow more efficient working practices and reduce stress for the patient. In the field of medicine, an article reports data obtained by a fluorescence imaging system in non-clinical and clinical studies of photodynamic immunotherapy (NIR-PIT), a novel cancer treatment. Also, in an example of a non-medical application of medical technology, an article describes the features and components of a multi-device biometric system that can be used to objectively assess various products and user experiences, and an example assessment performed using the system.

5. Green Technology

Also summarized in this special issue is Shimadzu's analytical and measurement technology developed to support a decarbonized society. The issue describes analytical equipment used in monitoring and quality control of biomanufacturing processes, a smart foundry that leverages AI and robotics at a newly-built biomanufacturing facil-

ity in Kobe, and prospects for innovation and adoption of new green technology through collaboration with Japanese and overseas companies and research institutions.

Also covered is a modular autonomous laboratory called Autonomous Lab being validated for bioproduction applications, and data that demonstrates the performance of Autonomous Lab in an example optimization of culture conditions. In the field of environmental science, this special issue presents case studies involving PFAS, a group of synthetic chemicals subject to increasingly stringent regulations throughout the world. An LC/MS/MS liquid chromatograph-mass spectrometer is used to analyze tap water for PFAS, presenting a highly accurate and reliable method for measuring levels of multiple PFAS in a single analysis.

6. Industry & Materials

This special issue provides an overview of Shimadzu technology that has shaped industrial development. The issue looks back at key examples of this influence, including batteries, vacuums, X-rays, chromatographs, optics, and materials science, and also covers new technologies currently in development. This special issue also describes quantum infrared spectroscopy as an example of quantum sensing technology. This new technique uses the correlated characteristics of quantum-entangled photon pairs to perform infrared absorption spectroscopy with a visible light detector, an approach that promises improved sensitivity and a wider dynamic range. A high-speed video camera is also described that can visualize previously unobservable phenomena at ultra-high recording speeds of 20 million fps. Additive manufacturing, or 3D printing, is also an extremely popular field of development. This issue explores metal extrusion (MEX), an additive manufacturing method, and the MEX additive manufacturing process, including feedstock, equipment, materials, printing, debinding, sintering, and the physical properties of sintered parts. Trends and future prospects for this technology are also discussed.

7. Conclusions

What technologies and information will Shimadzu publish during its next 50 years of operations? What data will analytical and measuring equipment produce in the age of AI? How will quantum technology develop and how will it shape society? How will healthcare be shaped by DNA analysis and gene editing, and can people achieve health and happiness through food?

Who will be responsible for shaping the health and well-being of the planet and its people 50 years from now?

The future is difficult to predict, but at Shimadzu, we hope to continue to inspire future engineers and extend our legacy of scientific and technological innovation.

“Contributing to Society Through Science and Technology”

The ambition communicated in Shimadzu's corporate philosophy remains our unchanging mission.