Preface to Special Issue "Development of Advanced Core Technology"

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1. Introduction

With its corporate philosophy of "**Contributing to Society through Science and Technology**", advanced technological development is the engine that drives future growth at Shimadzu. Over the next 10 years, Shimadzu's performance will be dictated by which of its current business domains and core technologies it chooses to develop, and which advanced technologies it decides to integrate and cultivate.

Based on Shimadzu's current business domains and current trends, Shimadzu's primary objectives are (1) a society that enables human happiness and a long healthy lifespan, and (2) a society that offers sustainable development.

At present, Shimadzu is expanding its business in four key growth areas: "**Healthcare**", "**Infrastructure**", "**Materials**", and "**Environment/Energy**". In healthcare, Shimadzu is developing products that aid the early diagnosis, treatment, and outcome management of cancer and dementia among other diseases, all based on the concept of advanced healthcare that integrates medical and analytical solutions. Going forward, Shimadzu hopes to place a greater emphasis on pre-disease onset solutions, such as products related to predicting disease onset, preventing disease, and anti-aging applications.

Mainly in its Technology Research Laboratory, Shimadzu is also carrying out research and development in three key evolving technology domains: "**Advanced Analysis**", "**Brain and Five Senses Technology/ Innovative Biotechnology**", and "**AI/Robotics**".

From these key growth areas and key evolving technology domains, Shimadzu selects specific topics for technology research and development. This special issue of Shimadzu Review presents 12 advanced technologies (grouped by market domain) from the range of technologies developed by Shimadzu since the previous special issue on advanced core technology development (published March 2016).

2. Materials

The functional materials industry is one of Japan's strongest industries, but with the recent emergence of new methods of developing functional materials such as material informatics (MI), maintaining Japan's position of strength within this industry has become an immediate concern in which analytical instruments are expected to play a key role. Traditional X-ray absorption has difficulty capturing internal features in light element materials, but "**Development of the X-ray Phase Imaging Device for Industrial Applications**" offers excellent visualization of these features and seems ideally suited to applications in the research, development, and testing of carbon fiber reinforced polymers (CFRPs).

3. Environment and Energy

Significant momentum has gathered behind global efforts to reduce CO_2 emissions and address other environmental issues, with some countries now taking advantage of legal avenues to accelerate the switch from gasoline and diesel vehicles to electric vehicles. One issue that is slowing this switch is how to extend the lifespan of the batteries used in electric vehicles. To date, only facilities equipped with a synchrotron have been able to analyze the chemical state of cathode materials in lithium-ion batteries (LIBs), but "**Development of Polychromatic Simultaneous Wavelength Dispersive X-ray Fluorescence Spectrometer**" allows this type of analysis to be performed in any laboratory, and promise to play an important role in extending the lifespan of LIBs.

4. Infrastructure

Due to a rapid surge in aging structures, shortages of inspection personnel, and problems with knowledge transfer, there is a growing demand to improve efficiency and reduce labor requirements in the inspection of public and industrial infrastructure, and a growing trend away from traditional manual and human-based inspections towards the use of IoT sensors. "**Application Study of Defect Visualization Technology Using Ultrasonic Wave and Light to Infrastructure**" visualize cracks and other defects near an object's surface. This technology can detect cracks under paint in concrete and steel members not traditionally detectable by nondestructive methods, which shows promise for applications in the inspection of infrastructure, aircraft, and other items.

5. Healthcare

Shimadzu is also addressing new areas in healthcare (life science) including cells, microbes, and regenerative medicine. "**Development of Hydrogels Based on the Amphiphilic Copolymers Poly (Sarcosine) and Poly (L-Lactic Acid)**" can be used to grow highly functional and safe three-dimensional cell cultures for applications in regenerative medicine. Mass spectrometry technology forms the core of Shimadzu's analytical technologies in advanced healthcare, and this section presents several topics of research and development involving mass spectrometry, including "**Development of Novel Tandem Mass Spectrometer Using Gas-Phase Radicals**" to offer a technology that complements collision-induced dissociation (CID), and utilizing AI to "**LC-MS Interface Parameter Optimization for High Sensitivity Measurement**".