

Preface to Special Issue “Diagnostics”

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1. Introduction

Green innovation is a concept defined by the sustainable growth of society and using every type of science, technology, and innovation to create change and address environmental issues that pose a global challenge. Creating a positive cycle of societal growth and environmental preservation that are interdependent and mutually sustainable is vital to green innovation. Outside Japan, the governments of Europe, the U.S., and China have committed resources to support the development and adoption of green energy technologies. In Japan, the Green Innovation Fund has been established to promote technological development and strengthen international competitiveness in 19 areas of green innovation.

In 2015, the Paris Agreement was adopted by countries at the UN Climate Change Conference (COP 21) with the aim of resolving the global issue of climate change. The long-term goal of the Paris Agreement is to hold the rise in global average temperature to well below 2 °C above pre-industrial levels (2 °C goal) while pursuing efforts to limit the temperature increase to no more than 1.5 °C above pre-industrial levels. The Paris Agreement also aims to reduce greenhouse gas emissions and reach a net balance between greenhouse gas emissions and removals (by forests, etc.) in the latter half of the 21st century.

Given the risk of livelihood disruption due to rising sea levels, abnormal weather due to climate change, and food shortages due to drought caused by global warming, global efforts to achieve carbon neutrality are an urgent priority. Carbon neutrality is a state where total emissions and removals of greenhouse gases cancel out to zero, and in October 2020, the Japanese government pledged to reduce overall (net) greenhouse gas emissions to this level by 2050. Efforts are now underway to develop innovative technologies to reduce carbon dioxide and other greenhouse gas emissions, increase greenhouse gas removal through plant and forest management, adopt renewable energy sources, and generate raw materials from CO₂ via methanation technology and microorganisms.

This special issue of Shimadzu Review presents examples of technological developments and products developed by Shimadzu that address this major global social trend.

2. Microbial Production

In light of Japan’s goal of net zero greenhouse gas emissions by 2050, Shimadzu has been strengthening its research and development initiatives into microbial production, including “synthetic biology” technology that offers efficient methods of producing fuels and bioplastics by feeding genetically engineered microorganisms carbon dioxide. The articles presented in this section describe technology developed through collaborations with Kobe University and Bacchus Bio Innovation Co., Ltd.

3. Sustainable Development Goals (SDGs): The 3Rs

The 3Rs (reduce, reuse, and recycle) are essential for reducing CO₂ emissions during product manufacture. The articles in this section describe technology used to analyze the properties of plastics and organic materials during recycling and upgrading the electrical control unit of an existing product to help reduce CO₂ emissions over its product life-cycle by extending service life.

- 1) FTIR Analysis of Plastics in the Context of Green Innovation
- 2) Development of “Autograph X-V Retrofit” Precision Universal Testing Machine Partial Update Kit

4. Environment

Each year, around 8 million metric tonnes of plastic waste are believed to enter the ocean, and these ocean plastics are predicted to exceed the weight of fish in the oceans by 2050. Ocean plastics that have been decomposed by waves, ultra-violet light, and other environmental factors into particles 5 mm or smaller are called microplastics. Microplastics are believed to undergo no further natural decomposition and persist in the environment. Efforts are also being made to reduce atmospheric emissions of volatile organic compounds (VOCs) by implementing emission controls and voluntary initiatives at factories and other fixed sources of emissions.

The articles in this section describe technology used to evaluate ocean plastics and microplastics and technology used to measure VOCs in China.

- 1) Analyzing a Selected Mixture of Plastics by Pyrolysis GC/MS for Applications in Microplastics Analysis
- 2) Study on Degradation Mechanisms and Safety Evaluation of Marine Biodegradable Plastics
- 3) Prototype Development of a Portable GCMS for VOCs Analysis

5. Materials and Batteries

New materials are being developed for energy conservation, storage batteries, and other applications aimed at carbon neutrality. Methods are being developed to evaluate these materials at the nanoscale and based on particle shape, while a variety of new materials are being developed for energy applications and weight reduction. The articles in this section present five examples of evaluation technologies and products in these fields.

- 1) Measuring Local Material Properties with the SPM-Nanoa Scanning Probe Microscope - Applications in Materials Development for Carbon Neutrality -
- 2) iSpect DIA-10 Dynamic Particle Image Analysis System
- 3) IRXross for Applications in Green Innovation and Various Other Fields
- 4) Application of X-Ray Phase Imaging for CFRP Evaluation
- 5) Visualization of Mechanical Behavior in the Deformation Process of 6061 Aluminum Alloy Using Mecholuminescent Material

6. CO₂ Reduction

Reducing CO₂ emissions is an urgent issue in the quest to achieve a decarbonized society, with technologies being developed to remove, reduce, and prevent CO₂ emissions. The articles in this section describe examples of the quantitative analysis of the fixed CO₂ and the monitoring of CO₂-fixing processes.

- 1) Using TOC to Evaluate CO₂ Fixation for a Carbon Neutral Society
- 2) Gas Measurement in the Development of Carbon Neutral Technology

7. Conclusions

The social issues addressed by green innovation are also global issues and the articles in this special issue cover a wide range of fields. We hope this special issue will have a positive impact in minimizing the effects of global warming and advance technological development in the right direction by encouraging collaboration with external organizations.