Preface to Special Issue "Material"

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1. Introduction

Scientific and technological progress has brought radical changes to the world we live in. Since it was founded in 1875, Shimadzu has developed and launched numerous products according to a corporate philosophy of "Contributing to Society through Science and Technology", and will continue to do so for many years to come. Shimadzu applies its technology and expertise to improve the well-being of mankind and the earth, and in recent years has chosen to focus these efforts on healthcare, infrastructure, materials, and environment/energy. Shimadzu aims to benefit society in each of these areas through a variety of approaches, including by developing new products, through collaborative research projects, and by developing applications for its products.

Materials form a cornerstone in our quality of life, and this special issue of Shimadzu Review focuses on Shimadzu's endeavors in this growing field. Materials have become a popular area of research and development in universities and companies, where efforts are focused on developing new and innovative materials. In turn, this creates a market for instruments with new measurement technologies able to properly evaluate these new materials. Furthermore, as new materials are developed, new technologies are needed to improve the production of those materials. Accordingly, as well as simply working on measurement techniques, it is critical that Shimadzu pursue all forms of materials-related technological development.

2. Developing Measuring Instruments to Evaluate New Materials

This section outlines three newly developed measuring instruments for materials evaluation.

The first instrument is the AGX-V series of precision universal testing machines. The AGX-V series of machines evaluates static mechanical strength, the most basic evaluation performed on public infrastructure and structural materials in particular. The AGX-V series is designed for ease of operation and safety, and is equipped with self-diagnostics and smart control features in addition to improved basic performance in measurement and control.

The next instrument is the HITS-X series of high-speed impact testing machines. The HITS-X series of machines measures dynamic mechanical strength, which is used to evaluate the safety and reliability of materials and components. The HITS-X series was developed to offer a testing machine that can evaluate how materials and components react under real-world operating conditions, to evaluate the performance of materials and components under the excessive loads that occur during accidents, and provide information to users not available from traditional static mechanical tests.

The last instrument is the iSpect DIA-10 dynamic image analysis system, which offers a new approach to particle characterization. The iSpect DIA-10 captures images of each individual particle and uses this vast number of particle images to determine the particle size distribution, measure the particle number concentration, perform particle shape analysis, and detect foreign objects.

3. New Applications for Measuring Instruments in Materials Evaluation

This section outlines two example applications for measuring instruments in materials evaluation.

Evaluating a given material with techniques not traditionally used to evaluate that material can offer new evaluation indicators. Temperature modulated differential scanning calorimetry (TMDSC) is a new thermal

evaluation technique for polymer materials. Thermal analysis is normally performed by observing changes in the test material while the temperature varies at a constant rate. TMDSC combines periodic modulations in temperature with constant rate temperature control to measure three parameters (total heat flow, reversing heat flow, and non-reversing heat flow), offering new information on the physical properties of materials not offered by previous thermal analysis methods.

Carbon fiber reinforced thermoplastics (CFRTPs) are expected to improve energy efficiency and reduce the environmental impact of the transportation industry when used in vehicles. In another example application, measuring instruments were used to evaluate the velocity dependence and temperature dependence of CFRTPs to qualify CFRTP performance in transport vehicle applications. The evaluation revealed that CFRTP material properties varied depending on how the CFRTP material was reinforced.

4. Conclusions

Innovative materials have brought substantial performance improvements to a variety of products in many industries, including automobiles (polypropylene for automobiles, polymer glass), semiconductors (semiconductor encapsulants, packaging substrates), household electric appliances (chemically strengthened glass, rechargeable lithium-ion batteries), and healthcare (superabsorbent polymers, non-woven fabrics). The development of new materials is expected to become increasingly popular given the market demand for smarter materials, thinner and lighter materials, wearable materials, and shape-conforming materials. Shimadzu is dedicated to developing measuring instruments for materials evaluation applications that meet the changing business conditions associated with these innovations, and is dedicated to developing rapid solutions to any potential challenges faced in new materials evaluation. New materials can only be utilized to their full potential when there are proper methods of evaluating those materials that can assure their safety and reliability.

Shimadzu is committed to developing measuring technologies that can play an integral role in the development of innovative material technologies.