



# 橋 THE BRIDGE

## MATERIALS ANALYSIS

### eNEWSLETTER

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## WELCOME

Rigaku would like to thank everyone who attended the 71<sup>st</sup> Annual Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (Pittcon 2020), held the first week of March in Chicago, where we were pleased to present our latest benchtop X-ray diffraction (XRD), X-ray fluorescence (XRF), handheld Raman and laser induced breakdown spectroscopy (LIBS) instrumentation.

The increasing spread of the novel coronavirus (COVID-19) has, unfortunately, resulted in the postponement or cancellation of a number of other planned events. ARABLAB has been rescheduled to September 7-9, 2020 and analytica will now take place from October 19-22, 2020. A complete listing of all upcoming Rigaku events is available [here](#).

We encourage everyone to stay informed about COVID-19 developments by visiting the [World Health Organization](#) website for updates.

In this issue of *The Bridge*, we feature a *Rigaku Journal* article exploring the characterization of lithium-ion battery materials. The article introduces examples of characterizing these materials using operando measurement, which is now possible with lab-scale X-ray diffractometers due to improved performance of X-ray sources, optical elements, and detectors.

An application report covering the analysis of biological specimens by electron microscopy is also included. The report discusses X-ray imaging of structures that range in size down to sub-micrometers, and highlights the performance of the [Rigaku nano3DX](#) X-ray microscope.

This month's WDXRF application note presents an improved method for determining total iron in iron ores by the pressed powder method, which covers crude iron ores and agglomerates.

The EDXRF application report describes the measurement of low levels of nickel and vanadium in crude to meet the NYMEX/CME specifications for light sweet crude oil futures in accordance with ASTM D8252.

As always, a collection of news reports covering the latest developments in materials science is included, along with a featured video presenting an intriguing exploration of the relationship between a chemist and the elements, which is shown to be more complicated, and more personal, than one might imagine.

We wish you all the best and good health!

## UPCOMING RIGAKU EVENTS

**XOPT2020 & PMJ**  
Online Event  
April 19-24, 2020

**Midwest Hazmat Conference**  
Northbrook, IL  
May 1-2, 2020

**Cofrend Days**  
Marseille, France  
May 12-14, 2020

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## FEATURED JOURNALS & REPORTS



### Journals

#### Characterization of Lithium-ion Battery Materials

By Yuji Shiramata, Rigaku Corporation & Takayuki Konya, Rigaku Europe SE

To examine the crystallization and phase ID analysis of synthesized battery materials, lab-scale X-ray diffractometers that are readily available for research are frequently used. On the other hand, *operando* (or *in-situ*) measurement of the changes in the crystal structure of the positive and negative electrode materials during the charging and discharging processes are frequently conducted at synchrotron facilities where high-intensity X-rays are available. Recently, *operando* measurement has become possible even with lab-scale X-ray diffractometers due to improved performance of X-ray sources, optical elements, and detectors. This article introduces examples of characterizing lithium-ion battery materials using SmartLab.

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### Journals

#### Application of the nano3DX X-ray Microscope to Biological Specimens

By Naoki Kunishima, Rigaku Corporation

Structural biology aims to understand life from observation of relevant biological structures and then to extend that knowledge to advance medicine, pharmaceutical development and so on. Because biological systems generally have hierarchical structures, the observation of biological systems varies in size range whether one is looking at tissue level structures, cellular structures or at molecular structures. Observation of these various biological samples is currently accomplished using various methodologies, including electron microscopy. In this report, we will discuss an X-ray imaging of structures that range in size down to sub-micrometers.

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## FEATURED PRODUCTS



#### SmartLab®

Rigaku SmartLab is the newest and most novel high-resolution X-ray diffractometer (XRD) available today. Perhaps its most innovative feature is the new SmartLab Studio II software, which provides the user with an intelligent User Guidance expert system functionality that guides the operator through the intricacies of each experiment. It is like having an expert standing by your side.

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#### NANOPIX mini

Rigaku NANOPIX mini is the world's first benchtop small-angle X-ray scattering (SAXS) system that is engineered to deliver automatic nanoparticle size distribution analysis for both quality control (QC) and research and development (R&D) applications. Nanoparticle size, size distribution, and particle shape are the key pieces of information obtained from SAXS.

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## FEATURED APPLICATION NOTES



### XRF

#### Quality and Process Control of Natural and Processed Iron Ores by the Pressed Powder Method on SimultixIS

Rigaku Corporation

The volume of seaborne trade and the price of iron ore have been globally increasing in recent years. For the iron ore industry, highly accurate analysis of total iron content in iron ore is a focal point. This note demonstrates the improved method to determine total iron in iron ores by pressed powder method, which covers crude iron ores (low and high content iron ores) and agglomerates (pellet and sinter).

[Read More >](#)



### EDXRF

#### Metals in Crude and Residual Oil

Applied Rigaku Technologies

The quality and grade of crude oil in part depends on the metal content as well as the sulfur content. Nickel and vanadium are the critical metals, as well as iron in some crudes and in residual oils and the metal content is especially important in the quality of bunker fuels. ASTM D8252 addresses the need to measure low levels of nickel and vanadium in crude to meet the NYMEX/CME specifications for light sweet crude oil futures contract concerning maximum allowable levels the Ni and V.

[Read More >](#)

## FEATURED VIDEO & USEFUL LINK OF THE MONTH



#### Martyn Poliakoff: The elements of chemistry

In this lecture, Sir Martyn will show how the relationship between a chemist and the elements is more complicated and more personal than you might imagine. He will describe how his varied with different elements has been very varied.



#### Corrosion Source

Corrosion Source is gateway to corrosion resources for materials industry professionals and researchers including useful links to an impressive library of technical literature and handbooks, current topics of interests and a learning center with information for both amateurs and professionals.

## MATERIALS ANALYSIS IN THE NEWS

**February 17, 2020:** Microfibers are a subset of microplastics: tiny pieces of petroleum-based materials that break down from larger plastic pieces or are manufactured at microscopic size. [A new study analyzes the global distribution and concentration of microfibers.](#)

**February 20, 2020:** Researchers at The University of Tokyo's Institute of Industrial Science, have developed [a new procedure for recycling concrete with the addition of discarded wood](#). They found that the correct proportion of inputs can yield a new building material with a bending strength superior to that of the original concrete. This research may help drastically reduce construction costs, as well as slash carbon emissions.

**February 24, 2020:** In a future built on quantum technologies, planes and spaceships could be fueled by the momentum of light. However, before this future can come to pass, we need bright, on-demand, predictable sources of quantum light. A team of Stanford University material scientists, physicists and engineers, in collaboration with labs at Harvard University and the University of Technology Sydney, continue to investigate [hexagonal boron nitride, a material that can emit bright light as a single photon – a quantum unit of light – at a time](#). Moreover, it can do this at room temperature, making it easier to use compared to alternative quantum sources.

**February 26, 2020:** Metal-organic frameworks (MOFs) are promising materials for inexpensive and less energy-intensive gas separation even in the presence of impurities such as water. A team of Hokkaido University researchers in collaboration with a group at the Technical University of Munich conducted a series of measurements on [the performance of a prototypical MOF to ascertain the material's real-world selectivity](#), for both completely dry frameworks and ones pre-exposed to water.

**February 26, 2020:** Some molecules, including most of the ones in living organisms, have shapes that can exist in two different mirror-image versions. The right- and left-handed versions can sometimes have different properties, such that only one of them carries out the molecule's functions. Now, a team of physicists has found that a similarly asymmetrical pattern can be induced and measured at will in certain exotic materials, [using a special kind of light beam to stimulate the material](#).

**February 28, 2020:** A team from the University of California San Diego and Quantitative BioSciences has a new approach to [continuously monitoring of heavy metal contamination in drinking water using bacteria as sensors](#) of contamination. The team recently published their advances in the journal *Proceedings of the National Academy of Science (PNAS)*.

**February 28, 2020:** In an article published in *Science Advances*, Rensselaer Polytechnic Institute researchers detailed how they [designed and synthesized a unique material with controllable capabilities](#) that make it very promising for future electronics.

**Feb 29, 2020:** New research suggests Earth was created in a fraction of the time scientists previously thought it formed, suggesting that rapidly forming planets could exist elsewhere. Published in *Science Advances*, the research suggests [the formation of Earth was through a million years, faster than in astronomical timescales](#).

**March 7, 2020:** Extreme temperature can do strange things to metals. In severe heat, iron ceases to be magnetic. In devastating cold, lead becomes a superconductor. A Cornell collaboration led by physicist Brad Ramshaw, the Dick & Dale Reis Johnson Assistant Professor in the College of Arts and Sciences, used a combination of ultrasound and machine learning to narrow the possible explanations for [what happens to this quantum material when it enters this so-called "hidden order."](#)

**March 3, 2020:** Ever wish your computer could think like you do or perhaps even understand you? That future may not be now, but it's one step closer, thanks to scientists and engineers and their recent discovery of [a materials-based mimic for the neural signals responsible for transmitting information within the human brain](#).

**March 7, 2020:** A SpaceX Dragon cargo spacecraft delivered more than 4,300 pounds of NASA cargo and science investigations, including a new science facility scheduled to be installed to the outside of the station during a spacewalk this spring. The spacecraft launched on a Falcon 9 rocket from Space Launch Complex 40, at Cape Canaveral Air Force Station in Florida.

**March 9, 2020:** In the field of 2D electronics, the norm used to be that graphene is the main protagonist and hexagonal boron nitride (hBN) is its insulating passive support. Researchers of the Center for Hexagonal Carbon Materials (CMCM) within the Institute for Basic Science (IBS, South Korea) made a [discovery that might change the role of hBN](#). They reported that stacking of ultrathin sheets of hBN in a particular way creates a conducting boundary with zero bandgap. In other words, the same material could block the flow of electrons, as a good insulator, and also conduct electricity in a specific location. Published in the journal *Science Advances*, this result is expected to raise interest in hBN by giving it a more active part in 2D electronics.

**March 9, 2020:** Since the outbreak of a novel coronavirus called SARS-CoV-2 started at the end of 2019, countries around the world have been working to contain the spread. As numbers of cases and deaths continue to rise, travel and work is being disrupted, but [researchers are also racing to find out as much as they can about the virus and how to treat it](#).

**March 11, 2020:** Researchers are reporting details of the atmosphere of a very hot exoplanet with a feature that sounds like something out of science fiction: [a rain of liquid iron falling through the night atmosphere](#). The researchers focus on the absorption of light by iron atoms, which will be in the vapor phase at the temperatures found on WASP-76b.

**March 10, 2020:** A novel underwater adhesive technology, based on a glue used naturally by marine creatures, soon may provide a safer adhesive option for industries ranging from biomedical to aerospace. [Mussel Polymers Inc. \(MPI\)](#) – a startup created by [Wardenslyffe Chemicals Inc.](#), a technology development company – has licensed this patented adhesive technology from the [Purdue Research Foundation](#). The adhesive is called poly(catechol-styrene), or PCS.

**March 10, 2020:** Nikhil Gupta, professor of mechanical and aerospace engineering at the New York University Tandon School of Engineering, received the prestigious [Brimacombe Medalist Award](#), presented each year to an elite group of researchers by [The Minerals, Metals and Materials Society \(TMS\)](#), a professional organization with nearly 14,000 members worldwide. Gupta was honored for [innovations in the development of lightweight porous materials](#) and for commitment to educating the public about the impact of materials research on society.

**March 17, 2020:** The U.S. Department of Energy (DOE) announced a plan to provide \$60 million to [establish multidisciplinary teams to develop new tools and techniques to harness supercomputers for scientific discovery](#). The program, known as SciDAC, or Scientific Discovery through Advanced Computing, brings together experts in computer science and applied mathematics with researchers in specific scientific disciplines to develop new high-performance computing tactics for tackling scientific questions.

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