Rigaku
Leading With Innovation

X-ray Diffraction & Elemental Analysis

NEX DE – High-resolution elemental analysis of sodium (Na) through uranium (U)

Fast Silicon Drift Detector (SDD) EDXRF spectrometer

As a premium high-performance benchtop EDXRF elemental analyzer, the Rigaku NEX DE delivers wide elemental coverage with an easy-to-learn Windows®-based QuantEZ software. Non-destructively analyze from Na through U in almost any matrix, from solids and alloys to powders, liquids and slurries. **For more >**

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The Bridge now welcomes manuscripts, communications, and

Welcome

As we move into February, please consider visiting us at one of the many events that we plan to attend this spring. The Pure and Applied Chemistry International Conference (PACCON 2019) takes place in Bangkok, Thailand this year on February 7 – 8. At the end of the month, we will be at the International Aluminium Recycling Congress in Comar, France on February 26 – 27.

The sunrise on New Year's Day at Minatomirai in Yokohama, Japan

The featured article this month covers the use of SmartLab for various pole figure measurement techniques to assist in thin film characterization.

This month's featured XRD technical note discusses evaluation of microscopic regions of carbide tools. The WDXRF application note explores the measurement of boron in glass powder while the EDXRF note covers agricultural soils and plant materials.

The book review covers *The Skeptics Guide to the Universe: How to Know What's Really Real in a World Increasingly Full of Fake* by Steven Novella. Check out the interesting video about the use of a novel high-speed soft X-ray camera to study the sun. And, as always, the news and papers sections are at the bottom of the page for a taste of the latest developments in materials science.

R.C. Tisdale, Ph.D. – Editor

Featured Rigaku Journal Article

Various pole figure measurement techniques with SmartLab, assisting thin film characterization

Rigaku Corporation

A pole figure (PF) measurement is an X-ray diffraction technique employed for the

papers that describe techniques and applications of all forms of X-ray fluorescence (XRF) and X-ray diffraction (XRD, including SAXS) that are of interest to fellow scientists in industry, academia, and government. Manuscripts, in PDF format, are only accepted with the understanding that they are not commercial in nature. Authors are responsible for all statements made in their work. If illustrations or other material in a manuscript have been published previously, the author is responsible for obtaining permission to republish. Please email copy to the editor.

Benchtop chemical crystallography system for 3D small molecule structure determination

XtaLAB mini II

The Rigaku XtaLAB mini II benchtop X-ray crystallography system is a compact single crystal X-ray diffractometer designed to produce publication-quality 3D structures. The perfect addition to any synthetic chemistry laboratory, the XtaLAB mini II will enhance research productivity by offering affordable structure analysis capability without the necessity of relying on a departmental facility. With the XtaLAB mini II, you no longer have to wait in line to determine your structures. Instead your research group can rapidly analyze new compounds as they are synthesized in the lab.
For more >

observation of textures in polycrystalline materials in the form of bulk ceramics, metal complex, thin films, etc, or the analysis of the orientation or domain configuration of epitaxial thin films. A comprehensive explanation of pole figures can be found in the technical article "X-ray thin film measurement techniques" in the Rigaku Journal. However, we often receive questions or requests for technical advice about PF measurements, especially for thin film samples. Users may wonder which of three PF measurement methods should be employed using a SmartLab system equipped with an in-plane axis and a 2D detector. **Full article >**

XRD Application Note

Measurement of microscopic regions using a high-speed 2-dimensional detector—Evaluation of microscopic regions of carbide tools

Rigaku Corporation

Carbide tools used for cutting are provided with various types of coatings to improve durability. Previously, evaluation of the coating layer has been done using X-ray diffraction, but some users want to achieve rapid and simultaneous evaluation of factors such as site-dependent differences in composition, crystallinity and orientation. These evaluations can be easily done by employing the optical element and detector used in this report. **For more >**

WDXRF Application Note

Boron analysis in glass powder with ZSX Primus IV using APC and a new synthetic multilayer analyzer RX85

Rigaku Corporation

Boron oxide (or boric acid) is an important compound for making glass. It is added to glass to decrease the softening temperature without changing the thermal expansion coefficient or chemical durability for glass. The boron element line, B-Kα, has a very long wavelength, making boron analysis by X-ray fluorescence (XRF) spectrometry difficult. Using a high power X-ray tube and an excellent synthetic multilayer analyzer has achieved excellent analysis results of boron oxide (B_2O_3) in glass by XRF. This Application Note demonstrates quantitative analysis results of B_2O_3 in glass by XRF. **For more >**

EDXRF Application Note

Agricultural soils and plant materials

Applied Rigaku Technologies

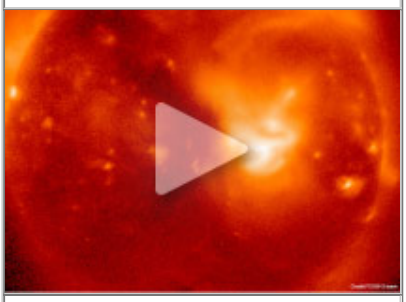
In the agri-food sector it is important to not only study the soil composition and use of fertilizers, but also the uptake of nutrients and potentially toxic elements within the plants and crops themselves. XRF (X-ray Fluorescence) is an accepted technique in the industry. The Rigaku NEX CG meets the challenges of soil and crop analysis using indirect excitation EDXRF (Energy Dispersive XRF). Secondary targets and polarization give the operator high precision instrumentation with a simple and intuitive software design ideal to meet the demanding trace measurements as well as the measurements of major and minor elements.
For more >

Book Review

The Skeptics Guide to the Universe: How to Know What's Really Real in a World Increasingly Full of Fake

By Dr. Steven Novella with Bob Novella, Cara Santa Maria, Jay Novella, and Evan

Video of the Month



Connecting the Dots: FOXSI-3 Data Points Add up to Unprecedented Image of Solar Corona

Scientists have begun analyzing data about the solar corona captured by the FOXSI-3 sounding rocket experiment. This is the world's first solar corona data where each soft X-ray was captured with high contrast, and high resolution in position, time, and energy. While this alone is outstanding, by combining the data points astronomers can create unprecedented images and graphs.

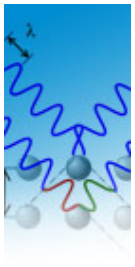
The solar corona is a layer in the Sun's atmosphere. It is filled with hot plasmas at temperatures of more than 1 million degrees Celsius. The corona is a dynamic environment where various energy releases occur, the most famous being solar flares. The coronal plasmas ejected by a solar flare can sometimes reach the Earth and affect our environment and technology. Thus, the study of the Sun has important practical applications.

The corona emits most of its light as X-rays. But X-rays are absorbed by the Earth's atmosphere, so observations from space are required.

Noriyuki Narukage, NAOJ Assistant Professor, and Shin-nosuke Ishikawa, a researcher at Nagoya University, together with the scientists at Kavli IPMU / The

Bernstei

The Skeptics Guide to the Universe is a wonderfully comprehensive work for anyone who already identifies as a skeptic or who wants to become a well-informed one. Podcast fans might recognize the title—it's shared with a weekly show hosted by Dr. Steven Novella and his team of co-authors. **Read review >**



Material Analysis in the News

News for January 2019

January 3, 2019. Researchers from Osaka City University (OCU) in Japan, Dr. K. Sugisaki, Profs. K. Sato and T. Takui and coworkers, have made a breakthrough in quantum chemistry by solving the Schrodinger Equation using a novel quantum algorithm.

January 3, 2019. Using the infrared camera of the AKARI satellite, a Japanese research team has detected the existence of water in the form of hydrated minerals in a number of asteroids. Researchers at Kobe University, the Japan Aerospace Exploration Agency and the University of Tokyo obtained spectra at near-infrared wavelengths from two to five micrometers, the spectral range within which hydrated materials can be detected and identified.

January 3, 2019. Researchers at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) have unveiled a clue into cuprates' unusual high-temperature superconducting properties – and the answer lies within an unexpected source: electron spin correlation. Researchers analyzed an exotic cuprate superconductor, Bi-2212, with a powerful technique called SARPES (spin- and angle-resolved photoemission spectroscopy).

January 7, 2019. Scientists in Japan report a method to make industrial polymers sticky without the need for adhesives. Researchers led by Assistant Professor Yuji Ohkubo of Osaka University found a way to create 'sticky' polydimethlysiloxane (PDMS), a silicon-based polymer, and 'sticky' plastic polytetrafluoroethylene (PTFE) by modifying the surfaces of both materials.

January 7, 2019. Scientists at Tokyo Institute of Technology have developed and analyzed a novel catalyst for the oxidation of 5-hydroxymethyl furfural, which is crucial for generating new raw materials that replace the classic non-renewable ones used for making many plastics.

January 11, 2019. Researchers at the University of Tokyo, the Japan Science and Technology Agency, Riken, and Tohoku University in Japan, have replaced the atoms of a carbon nanotube with phenine rings – derivatives of benzene where each molecule is a six-membered carbon ring. The result is a nanotube with periodic vacancies giving a porous crystal structure that is described as “simply and astonishingly, beautiful.”

January 16, 2019. Central to its deep commitment to honor the most innovative and meaningful advances worldwide, The Japan Prize Foundation announced the laureates of the 2019 Japan Prize, who have pushed the envelope in their respective fields of “Materials and Production” and “Biological Production, Ecology.” The materials science award went to Dr. Yoshio Okamoto, Professor Emeritus at Nagoya University in Nagoya, Japan. His research has contributed enormously to the development of basic science and industry by establishing the groundbreaking

University of Tokyo and Institute of Space and Astronautical Science / Japan Aerospace Exploration Agency (ISAS/JAXA), developed a high-speed soft X-ray camera and installed it on the sounding rocket FOXSI-3 which flew above the Earth's atmosphere for 6 minutes to observe the Sun. This camera was the first in the world to record individual solar soft X-rays with high contrast and high resolution in position, time, and energy.

Watch video >

Conferences and Workshops

Join Rigaku at future meetings

Rigaku will be sponsoring, attending or exhibiting at the following conferences and trade shows:

National Narcotics Officers Assocation Conference
Washington, D. C., US
February 3 – 6, 2019

PACCON 2019
Bangkok, Thailand
February 7 – 8, 2019

Analytical Equipment Expo
Osaka, Japan
February 20 – 22, 2019

See the complete list >

Useful Link of the Month

concept of asymmetric polymerization for the creation of a helical polymer and developed the results into a practical separation method for optically active drugs.

January 22, 2019. Using a new computational method, an international collaboration has succeeded for the first time in systematically investigating magnetic quantum effects in the well-known 3D pyrochlore Heisenberg model. The surprising finding: physical quantum phases are formed only for small spin values.

January 23, 2019. Scientists at the Okinawa Institute of Science and Technology have developed a process for the creation of perovskite cells with better than 20% efficiency. The cells use a tin-oxide electron transport layer, which the scientists say can triple their operational lifetime.

January 24, 2019. The National Institute for Materials Science, the University of Tokyo and Hiroshima University jointly discovered for the first time, through theoretical calculation and experiment, that macroscopic frictions occurring between clay mineral surfaces originate from interatomic electrostatic forces between these surfaces. This finding may facilitate the design of solid lubricant materials and understanding of earthquake-causing fault slip mechanisms.

January 28, 2019. In a discovery that could provide new insights into the origin of mass in the universe following the Big Bang, scientists from the international J-PARC E15 Collaboration, led by researchers from the RIKEN Cluster for Pioneering Research (CPR), have used experiments with kaons and helium-3 to experimentally demonstrate the existence of an exotic nucleus containing two protons and a bound kaon. Kaons are a type of meson - a group of extremely short-lived particles that mediate the strong force that binds protons and neutrons inside the atomic nucleus, consisting of an anti-quark and quark pair.

Recent Scientific Papers of Interest

Papers for January 2019

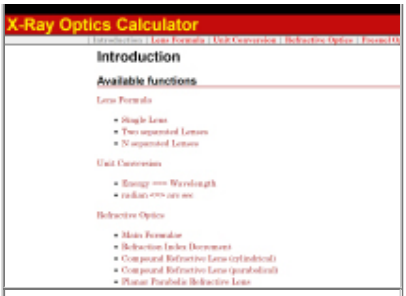
Recent Scientific Papers of Interest is a monthly compilation of material analysis papers appearing in recently released journals and publications. *See below*

Stacking fault reduction during annealing in Cu-poor $CuInSe_2$ thin film solar cell absorbers analyzed by *in situ* XRD and grain growth modeling. Stange, Helena; Brunken, Stephan; Greiner, Dieter; Heinemann, Marc Daniel; Barragan Yani, Daniel Antonio; Wägele, Leonard Alwin; Li, Chen; Simsek Sanli, Ekin; Kahnt, Max; Schmidt, Sebastian Simon; Bäcker, Jan-Peter; Kaufmann, Christian Alexander; Klaus, Manuela; Scheer, Roland; Genzel, Christoph; Mainz, Roland. *Journal of Applied Physics*. 1/21/2019, Vol. 125 Issue 3, pN.PAG-N.PAG. 11p. 2 Diagrams, 3 Charts, 3 Graphs. DOI: 10.1063/1.5052245.

Evaluation of ions and metals in the blood of GRMD dogs submitted to hASCs therapy by NAA and XRF techniques. Metairon, Sabrina; Zamboni, Cibele B.; Suzuki, Miriam F.; Bueno, Carlos R. *Applied Radiation & Isotopes*. Jan2019, Vol. 143, p107-112. 6p. DOI: 10.1016/j.apradiso.2018.10.024.

Microstructure evolution effect on high-temperature thermal conductivity of LDPE/BNNS investigated by *in-situ* SAXS. Li, Jia-long; Yin, Jing-hua; Ji, Tianyi; Feng, Yu; Liu, Yuan-yuan; Zhao, He; Li, Yan-peng; Zhu, Cong-cong; Yue, Dong; Su, Bo; Liu, Xiao-xu. *Materials Letters*. Jan2019, Vol. 234, p74-78. 5p. DOI: 10.1016/j.matlet.2018.09.061.

***In-situ* XRD studies of arc evaporated Al-Cr-O coatings during oxidation.** Dalbauer, V.;



X-ray Optics Calculator

Available functions include:

- **Lens Formula**
  - Single Lens
  - Two separated Lenses
  - N separated Lenses
- **Unit Conversion**
  - Energy <=> Wavelength
  - radian <=> arc sec
- **Refractive Optics**
  - Main Formulae
  - Refraction Index Decrement
  - Compound Refractive Lens (cylindrical)
  - Compound Refractive Lens (parabolical)
  - Planar Parabolic Refractive Lens
  - Planar Kinoform Refractive Lens
- **Fresnel Optics**
  - First Fresnel Zone Size
  - Fresnel Zone Plate
  - Composite Fresnel Zone Plate
- **Transmission through matter**
  - X-ray attenuation in air
  - X-ray attenuation in condensed matter
- **Transfocator**
  - Even set transfocator
  - Odd set transfocator
- **Table Data**
  - Elements data table
  - Compounds data table
  - Characteristic lines

For more >

Planning to submit a grant?

Kolozsvári, S.; Ramm, J.; Koller, C.M.; Mayrhofer, P.H. *Surface & Coatings Technology*. Jan2019, Vol. 358, p934-941. 8p. DOI: 10.1016/j.surfcoat.2018.12.012.

***In situ* XRD observation of CuO anode phase conversion in lithium-ion batteries.** Feng, Lili; Wang, Rui; Zhang, Yinyin; Ji, Siping; Chuan, Yongming; Zhang, Wei; Liu, Bo; Yuan, Chao; Du, Chenxing. *Journal of Materials Science*. Jan2019, Vol. 54 Issue 2, p1520-1528. 9p. 5 Graphs. DOI: 10.1007/s10853-018-2885-0.

Investigation of the order-disorder phase transition series in AuCu by *in-situ* temperature XRD and mechanical spectroscopy. Lamiri, Imene; Martínez-Blanco, David; Abdelbaky, Mohammed S.M.; Mari, Daniele; Hamana, Djamel; García-Granda, Santiago. *Journal of Alloys & Compounds*. Jan2019, Vol. 770, p748-754. 7p. DOI: 10.1016/j.jallcom.2018.08.094.

XRD analysis, Raman, AC conductivity and dielectric properties of Co and Mn co-doped SnO_2 nanoparticles. Bhakta, N.; Chakrabarti, P. K. *Applied Physics A: Materials Science & Processing*. Jan2019, Vol. 125 Issue 1, p1-1. 1p. DOI: 10.1007/s00339-018-2370-2.

Comparative study of radiation defect dynamics in 3C-SiC by X-ray diffraction, Raman scattering, and ion channeling. Bayu Aji, L. B.; Stavrou, E.; Wallace, J. B.; Boulle, A.; Debelle, A.; Kucheyev, S. O. *Applied Physics A: Materials Science & Processing*. Jan2019, Vol. 125 Issue 1, p1-1. 1p. DOI: 10.1007/s00339-018-2325-7.

Characterisation of size distribution and positional misalignment of nanoscale islands by small-angle X-ray scattering. Heldt, Georg; Thompson, Philip; Chopdekar, Rajesh V.; Kohlbrecher, Joachim; Lee, Stephen; Heyderman, Laura J.; Thomson, Thomas. *Journal of Applied Physics*. 2019, Vol. 125 Issue 1, pN.PAG-N.PAG. 8p. 2 Diagrams, 5 Graphs. DOI: 10.1063/1.5050882.

Coalescence mechanism of helium bubble during tensile deformation revealed by in situ small-angle X-ray scattering. Gao, Jie; Huang, Hefei; Liu, Jizhao; Zeng, Jianrong; Xie, Ruobing; Li, Yan. *Scripta Materialia*. Jan2019, Vol. 158, p121-125. 5p. DOI: 10.1016/j.scriptamat.2018.08.050.

Difference assessment of composite resins and sound tooth applicable in the resin-imbedded tooth for resin repair using fluorescence, microhardness, DIAGNOdent, and X-ray image. Jeong, Tae-sung; Park, Jeong-Kil; Ko, Ching-Chang; Garcia-Godoy, Franklin; Kwon, Yong Hoon. *Clinical Oral Investigations*. Jan2019, Vol. 23 Issue 1, p293-301. 9p. 3 Black and White Photographs, 2 Charts, 3 Graphs. DOI: 10.1007/s00784-018-2436-8.

X-ray fluorescence analysis of the Bakken and Three Forks Formations and logging applications. Yarbrough, Lance D.; Carr, Russell; Lentz, Nick. *Journal of Petroleum Science & Engineering*. Jan2019, Vol. 172, p764-775. 12p. DOI: 10.1016/j.petrol.2018.08.070.

Armstrongite at non-ambient conditions: An *in-situ* high-pressure single-crystal X-ray diffraction study. Comboni, Davide; Lotti, Paolo; Gatta, G. Diego; Lacalamita, Maria; Mesto, Ernesto; Merlini, Marco; Hanfland, Michael. *Microporous & Mesoporous Materials*. Jan2019, Vol. 274, p171-175. 5p. DOI: 10.1016/j.micromeso.2018.07.047.

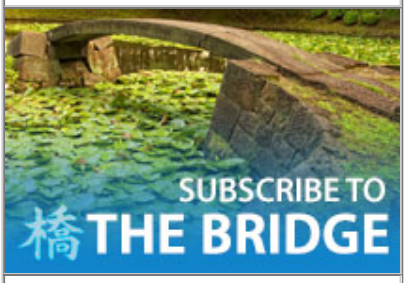
X-ray powder diffraction study of the stability of clathrate hydrates in the presence of salts with relevance to the Martian cryosphere. Safi, Emmal; Thompson, Stephen P.; Evans, Aneurin; Day, Sarah J.; Murray, Claire A.; Baker, Annabelle R.; Oliveira, Joana M.; van Loon, Jacco Th. *Geochimica et Cosmochimica Acta*. Jan2019, Vol. 245, p304-315. 12p. DOI: 10.1016/j.gca.2018.10.034.

The T phase with the V_6Si_5 type structure in the Mo-Si-Ti system studied by ab initio calculations and X-ray diffraction. Colinet, C.; Joubert, J.-M.; Tedenac, J.-C. *Scripta Materialia*. Jan2019, Vol. 159, p76-79. 4p. DOI: 10.1016/j.scriptamat.2018.09.006.

Rigaku is happy to assist

If you are planning on submitting an instrument grant proposal, Rigaku will be happy to assist you. We can help you determine the correct instrument and configuration best suited for your analytical needs. **Start the process >**

Rigaku's Materials Analysis eNewsletter, The Bridge



Join us

Each month, Rigaku distributes two eNewsletters: *The Bridge*, which focuses on Materials Analysis, and *Crystallography Times*, which concentrates on X-ray crystallography. **Join us >**

Effects of boron on structure of lanthanum and sodium aluminoborosilicate glasses studied by X-ray diffraction, transmission electron microscopy and infrared spectrometry. Mabrouk, A.; De Sousa Meneses, D.; Pellerin, N.; Véron, E.; Genevois, C.; Ory, S.; Vaills, Y. *Journal of Non-Crystalline Solids*. Jan2019, Vol. 503, p69-77. 9p. DOI: 10.1016/j.jnoncrysol.2018.09.030.

Imaging electron-density fluctuations by multidimensional X-ray photon-coincidence diffraction. Lyuzhou Ye; Rouxel, Jérémy R.; Daeheum Cho; Mukamel, Shaul. *Proceedings of the National Academy of Sciences of the United States of America*. 1/8/2019, Vol. 116 Issue 2, p395-400. 6p. DOI: 10.1073/pnas.1816730116.

On the presence of antisite defect in monoclinic Li_2FeSiO_4 — A combined X-Ray diffraction and DFT study. Milovic, Miloš D.; Vasic Anicijevic, Dragana D.; Jugovic, Dragana; Anicijevic, Vladan J.; Veselinovic, Ljiljana; Mitric, Miodrag; Uskokovic, Dragan. *Solid State Sciences*. Jan2019, Vol. 87, p81-86. 6p. DOI: 10.1016/j.solidstatesciences.2018.11.008.

Measurement of transformer solid insulation degradation using dilatometry and X-ray diffraction analysis. Mohan Rao, U.; Jarial, Raj Kumar. *Measurement* (02632241). Jan2019, Vol. 131, p701-705. 5p. DOI: 10.1016/j.measurement.2018.09.024.

Characterization on crystal structure of $CH_3NH_3PbI_xCl_{3-x}$ perovskite by variable temperature powder X-ray diffraction. Chen, Xue; Li, Ning; Li, Yuan; Che, Ping. *Materials Letters*. Jan2019, Vol. 235, p239-241. 3p. DOI: 10.1016/j.matlet.2018.09.151.