



Qualitative and quantitative analysis of polycrystalline materials



MiniFlex

The new sixth generation MiniFlex X-ray diffractometer (XRD) is a multipurpose analytical instrument that can determine: phase identification and quantification, percent (%) crystallinity, crystallite size and strain, lattice parameter refinement, Rietveld refinement, and molecular structure. It is widely used in research, especially in material science and chemistry, as well as in industry for research and quality control. It is the newest addition to the MiniFlex series of benchtop X-ray diffraction analyzers from Rigaku, which began with the introduction of the original MiniFlex system decades ago. **For more >**

Interested in publishing your work in The Bridge?



Publish Your Work Here

The Bridge now welcomes manuscripts, communications, and 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 send copy to the editor at Rigaku.newsletter@Rigaku.com

Micro-Z ULS – Measure ultra-low sulfur (ULS) in petroleum fuels by ASTM D2622-10



Wavelength dispersive X-ray fluorescence sulfur (S) analyzer

Designed for ultra-low level sulfur analysis of diesel, petrol (gasoline) and other fuels, the Rigaku Micro-Z ULS wavelength dispersive X-ray fluorescence (WDXRF) instrument features a novel design that measures both the sulfur peak and the background intensity. The ability to measure and correct for changes in background intensity delivers a better net peak intensity measurement, resulting in superior calibrations and enhanced real world precision. **For more >**

Video of the Month



Envisioning Chemistry: Reaction between Copper and Concentrated Nitric Acid

Yan Liang's Envisioning Chemistry series of videos aims to make simple chemistry beautiful. It features microscopy, high-speed and infrared footage of chemical transformations ranging from precipitation and crystal growth to metal displacement and combustion. "The idea is to make the glassware invisible and show the surprising beauty of simple chemical reactions close up." Liang says. **Watch video >**

Conferences and Workshops



Join Rigaku at future meetings

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

Gulf Coast Conference (GCC) 2017
Houston, TX, USA
January 17 & 18, 2017

AWA Global Release Liner Industry Conference & Exhibition
Amsterdam, Netherlands
February 14 – 16, 2017

See the complete list >

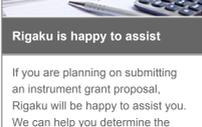
Useful Link of the Month



GNU Spacechart 3D star-mapping program

GNU SpaceChart is a 3D star-mapping program for GNOME, a desktop environment composed of free and open-source software that runs on Linux and most BSD derivatives. The program, which allows you to see the stars in glorious 3D and rotate them to see them from any point of view, can be [downloaded here](#).

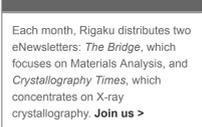
Planning to submit a grant?



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 >**

Welcome

Thanks again to everyone who came by our booths at Materials Research Society (Boston), PEFTEC 2017 (Antwerp) and the American Geophysical Union (New Orleans) this month. It was great to see everyone and to have the chance to talk about our new and exciting products. In January, we invite members of the petroleum and petrochemical communities to come see us at the Gulf Coast Conference, Jan 17 – 18 at the George R. Brown Convention Center in Houston.



Holiday season in New England by Kenichi Yaota of Rigaku Innovative Technologies

This month's issue contains a Rigaku Journal article describing thickness and composition analysis of thin film samples using the FP method by XRF analysis. A second featured article discusses SmartLab SE system's compliance with regulations/guidelines related to electronic records and signatures (ER/ES).

Application papers are also included for EDXRF, WDXRF, and XRD. The book review covers electrification and its impact on society. This month's video covers "Envisioning Chemistry," a project whose aim is to make simple chemistry beautiful and features microscopy, high-speed and infrared footage of chemical transformations. Check out the news and papers sections at the bottom of the page for the latest developments in materials science.

R.C. Tisdale, Ph.D. – Editor

Featured Rigaku Journal Article

Thickness and composition analysis of thin film samples using FP method by XRF analysis

By Hikari Takahara, Rigaku Corporation

X-ray fluorescence spectroscopy (XRF) is an elemental quantification analysis method for inorganic and metallic compounds. Sample preparation is simple and does not require solid samples to be dissolved, as is necessary for wet chemical analysis techniques. The fundamental parameter (FP) method implements quantitative analysis without type standards. The XRF technique has been widely accepted not only for bulk analysis but for thin film analysis in plating and electronic materials. With the thin film FP method, the thickness and composition of a thin film can be simultaneously determined, and the software is able to handle even complex multilayers. This article explains the basic principles of XRF thin film analysis; the depth of an XRF measurement and an overview of the thin film FP method. **Full article >**

Featured Rigaku Article

The SmartLab SE system complies with regulations/guidelines related to electronic records and signatures (ER/ES)

By Akito Sasaki, Rigaku Corporation

Manufacturing process and quality control departments in pharmaceutical companies are required to comply with regulations/guidelines such as FDA 21 CFR Part 11, EU-GMP Annex 11, PIC/S GMP guidelines, etc. The ER/ES mode of the SmartLab SE system with SmartLab Studio II complies with these regulations/guidelines, and it properly and reliably assists you with analytical procedures and data management. **Full article >**

Featured Event

29th International Conference on Defects in Semiconductors (ICDS)

Reported by Katsuhiko Inaba, Rigaku X-ray Research Laboratory, Rigaku Corporation

ICDS is well known as one of the most influential international conferences to focus on research into the fundamental properties and applications of defects in semiconductor materials. This year's meeting had 279 participants from 32 countries. The scope of this conference covered a wide range of defect physics and technologies, such as the physics of defects in semiconductor materials like Silicon IV-IV, III-V (including nitrides) or II-VI (including functional oxides) compound semiconductors, defects in organic semiconductors, defects controlling device performance, advances in defect computational methods, etc. **Full report >**

XRD Application Note

Characterization of a Next-Generation Magnetic Recording Media (FePt) by In-Plane X-ray Diffraction

Rigaku Corporation

As next-generation ultrahigh-density magnetic recording media, granular thin films in which metal microparticles are dispersed have been a focus of attention. Among these films, the regular phase (tetragonal crystal) of FePt has a particularly high magnetic anisotropy as well as good corrosion and oxidation resistance, so it is expected that it will be applied to actual devices. However, the irregular phase (cubic crystal) is created at the same time, depending on the filmforming conditions. For this reason, a technique to distinguish these crystalline phases at the nanoparticle and thin film level is required. **For more >**

XRD Application Note

Evaluation of stress distribution of a shot peened coil spring in the depth direction by electrolytic polishing

Rigaku Corporation

Shot peening is a surface treatment method mainly used to improve the durability and reliability of metal parts. Materials such as iron and ceramics are shot at the surface of metal parts at high speed to create compressive residual stress, which improves fatigue strength and durability against stress corrosion. Shot peening is applied, for example, to metal parts on aircraft and automobiles, pressure vessels in chemical plants, etc., which are used continuously for a long time. Residual stress measurement by X-ray diffraction is the most common method to evaluate the effect of the shot peening process. **For more >**

WDXRF Application Note

Analysis of Ultra Low Sulfur in Automotive Fuels According to ASTM D2622-10 by Sulfur Analyzer Micro-Z ULS

Rigaku Corporation

Recent developments in ultra low sulfur (ULS) fuel have improved fuel efficiency and created cleaner exhaust gases. Globally, the permitted sulfur limit in fuel oils has been decreased to 10 ppm in many countries and regions. For compliance verification, XRF spectrometry is the definitive analysis tool for use at distribution terminal and refineries, as well as mobile or stationary testing laboratories. In recent years, there has been an increasing need for an instrument which does not require the use of helium gas, for instances, when acquisition or delivery of helium to the analysis site is difficult. The Micro-Z ULS (ultra low sulfur) is a newly developed Sulfur analyzer which does not require helium gas in operation. **For more >**

EDXRF Application Note

Analysis of Finished Portland Cement

Applied Rigaku Technologies

EDXRF is a simple analysis technique used in cement plants around the world. The technique is ideal for QA/QC throughout the cement production process. EDXRF can be used as a screening tool and a quality control analyzer to ensure proper composition of incoming feedstocks, raw meal mixture balances, addition of gypsum and throughout the manufacturing process. The EDXRF analyzer also makes an excellent backup instrument for the WDXRF analyzer used for final QC and certification. **For more >**

Book Review

Simply Electrifying: The Technology that Transformed the World, from Benjamin Franklin to Elon Musk

Reviewed by Jeanette S. Ferrara, MA

A world without electricity would be a dark one indeed (both literally and figuratively). That's where Craig R. Roark starts *Simply Electrifying*: by asking the reader to imagine their world without the innumerable technologies that make our daily lives so much easier—technologies that predominantly run on electricity. **Full review >**

Material Analysis in the News

News for December 2017

December 1, 2017. Dr. Riko Muranaka, of Kyoto University, was awarded the **2017 John Maddox prize for her work uncovering the pseudoscience** at the heart of widespread fear in Japan about the HPV vaccine. The prestigious prize is awarded each year by the journal *Nature*, the Kohn Foundation, and the charity Sense about Science, to a person who promotes sound evidence in the face of hostility.

December 7, 2017. Scientists at Japan's Institute of Industrial Science, at the University of Tokyo, have developed a **new kind of semi-transparent solar cell**, based on perovskite and nano-sized cubes of silver, with a conversion efficiency of around 10%. The new cell, the research group claims, is able to increase the "plasmonic antenna effect", which enhances the cell's light absorption ability and, as a result, its conversion efficiency.

December 7, 2017. The U.N.'s **forecast for global warming is about 15 percent too low**, which means end-of-century temperatures could be 0.5 degrees Celsius higher than currently predicted, said a study released Wednesday. The prediction makes the already daunting challenge of capping global warming at "well under" 2.0°C (3.6 degrees Fahrenheit) — the cornerstone goal of the 196-nation Paris Agreement — all the more difficult.

December 11, 2017. Researchers at the Planetary Exploration Research Center (PERC), Chiba Institute of Technology and the Earth-Life Science Institute (ELSI), Tokyo Institute of Technology have performed **numerical simulations to explore the launch mechanism of Martian meteorites**. According to the knowledge of shock physics, a strong shock compression higher than 50 GPa is required to accelerate Martian materials up to the escape velocity of Mars (5 km/s). In contrast, detailed analysis of Martian meteorites shows that they suffer only 30-50 GPa during the ejection. The researchers found that a material pileup in an excavation flow causes a significant velocity boost of materials near the surface without strong compression. This newly discovered "late-stage acceleration" could play an important role not only in the launch of Martian meteorites, but also in the context of the (Litho-) Panspermia.

December 12, 2017. A group of scientists at Japan's RIKEN Center for Emergent Matter Science is developing a **new quantum-mechanical process to extract current from solar cells in a more efficient way**. The researchers have used electrocatalytic organic molecules to solve the problem of the lack of "intrinsic" symmetry of several semiconductor materials, as these spontaneously separate their positive and negative charges; a task that oxide ferroelectrics cannot achieve, because their atoms are flipped about the center of the repeating unit.

December 13, 2017. **New, unexpected paradigm discovered: Disorder may actually promote an exotic quantum spin liquid**, with potential for ultrafast computing. An elusive state of matter—quantum spin liquid—may actually be enhanced rather than suppressed by disorder as seen in a compound that contains praseodymium, zirconium, and oxygen.

December 17, 2017. A three-man astronaut crew featuring American and Japanese rookies and an experienced Russian cosmonaut blasted off Sunday for a six-month mission aboard the International Space Station. This is the **first space mission for Dr. Norihige Kanai, 41, formerly a diving medical officer with the Maritime Self-Defense Force**. He is the 12th Japanese astronaut and the third doctor-turned-astronaut in Japan. During his stay, about 30 experiments will be conducted in Kibo, Japan's experimental module. Kanai will be in charge of crystallizing proteins and raising a mouse. He is also slated to release an ultraspace satellite and conduct an experiment related to the field of materials science.

December 18, 2017. Japanese researchers say they have developed a **new type of glass that can heal itself from cracks and breaks**. Glass made from a low weight polymer called "polyether-thioureas" can heal breaks when pressed together by hand without the need for high heat to melt the material. The research by researchers led by Professor Takuzo Aida from the University of Tokyo, promotes healable glass that could potentially be used in phone screens and other fragile devices, which they say are an important challenge for sustainable societies.

December 18, 2017. A team of Japanese researchers has **developed a new approach for detecting cancer biomarkers in urine**. Using a device constructed of nanowires, the scientists were able to net over a thousand types of microRNAs, which they then transferred to a commercial microarray platform for analysis. Given the high yield of miRNA markers they were able to isolate, the researchers believe the approach could be commercialized and introduced into routine cancer testing.

December 19, 2017. Members of a research team from China's Bohai University and Northeastern University in Shengyang, and Japan's National Institute for Materials Science have combined rare-earth element nitrates with ammonia sulfates and hydrates and have synthesized a **new luminescent powdery substance that can convert electricity into light**.

Recent Scientific Papers of Interest

Papers for December 2017

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

Quick analysis of organic matter in soil by energy-dispersive X-ray fluorescence and multivariate analysis. Morona, Fransley; Dos Santos, Felipe R.; Brinatti, André M.; Melquiades, Fábio L. *Applied Radiation & Isotopes*. Dec2017, Vol. 130, p13-20. 8p. DOI: [10.1016/j.apradiso.2017.09.008](https://doi.org/10.1016/j.apradiso.2017.09.008).

Determination of trace elements in calcium rich carbonate rocks by Wavelength Dispersive X-ray Fluorescence Spectrometry for environmental and geological studies. Cherkashina, T.Yu.; Shtel'makh, S.I.; Pashkova, G.V. *Applied Radiation & Isotopes*. Dec2017, Vol. 130, p153-161. 9p. DOI: [10.1016/j.apradiso.2017.09.038](https://doi.org/10.1016/j.apradiso.2017.09.038).

A valence-selective X-ray fluorescence holography study of an yttrium oxide thin film. Stelhorn, J. T.; Hosokawa, S.; Happo, N.; Tajiri, H.; Matsushita, T.; Kaminaga, K.; Fukuikura, T.; Hasegawa, R.; Hayashi, K. *Journal of Applied Crystallography*. Dec2017, Vol. 50 Issue 6, p1583-1589. 6p. DOI: [10.1107/S1600576717012821](https://doi.org/10.1107/S1600576717012821).

Determination of demineralization depth in tooth enamel exposed to abusive use of whitening gel using micro-energy dispersive X-ray fluorescence. Pessanha, Sofia; Coutinho, Sara; Carvalho, Maria Luisa; Silveira, João Miguel; Mata, António. *Spectrochimica Acta Part B*. Dec2017, Vol. 138, p8-13. 6p. DOI: [10.1016/j.sab.2017.10.001](https://doi.org/10.1016/j.sab.2017.10.001).

Total Reflection X-Ray Fluorescence Determination of Rare Earth Elements in Mineral Water Using a Combined Preconcentration Technique. Oskolok, Kirill V.; Monogarova, Oksana V.; Alov, Nikolai V. *Analytical Letters*. 2017, Vol. 50 Issue 18, p2900-2907. 8p. 1 Color Photograph, 2 Charts, 2 Graphs. DOI: [10.1080/00032719.2017.1324468](https://doi.org/10.1080/00032719.2017.1324468).

A distance correction method for improving the accuracy of particle coal online X-ray fluorescence analysis – Part 2: Method and experimental investigation. Zhang, Yan; Jia, Wen Bao; Gardner, Robin; Shan, Qing; Zhang, Xin Lei; Hou, Guojing; Chang, Hao Ping. *Radiation Physics & Chemistry*. Dec2017, Vol. 141, p235-238. 4p. DOI: [10.1016/j.radphyschem.2017.07.004](https://doi.org/10.1016/j.radphyschem.2017.07.004).

Raman, X-Ray Fluorescence Spectroscopies and Graphene Oxide Modified Screen Printed Electrodes to Identify the Pigments and Earth Present in Ancient Leather Samples. Valentini, Federica; Bicchieri, Marina; Calcaterra, Andrea; Talamo, Maurizio. *Electroanalysis*. Dec2017, Vol. 29 Issue 12, p2873-2881. 9p. DOI: [10.1002/elan.201700457](https://doi.org/10.1002/elan.201700457).

X-ray diffraction and microstructure studies of Gull Arabic-cement concrete. Elinwa, Augustine U.; Umar, Mohammed. *Construction & Building Materials*. Dec2017, Vol. 156, p632-638. 7p. DOI: [10.1016/j.conbuildmat.2017.08.162](https://doi.org/10.1016/j.conbuildmat.2017.08.162).

Arrangement of GaN nanowires on Si(001) substrates studied by X-ray diffraction: Importance of silicon nitride interlayer. Wierzbicka, A.; Tchudylashvili, G.; Sobanska, M.; Klosek, K.; Minikayev, R.; Domagala, J.Z.; Borysiuk, J.; Zykiewicz, Z.R. *Applied Surface Science*. Dec2017, Vol. 425, p1014-1019. 6p. DOI: [10.1016/j.apsusc.2017.07.075](https://doi.org/10.1016/j.apsusc.2017.07.075).

Unraveling the electrochemical properties and thermal behavior of NaNi₂Sb₁₃O₂ cathode for sodium-ion batteries by in situ X-ray diffraction investigation. Dai, Hong; Yang, Chenghao; Ou, Xing; Liang, Xinghui; Xue, Hao; Wang, Wenxiang; Xu, Guofu. *Electrochimica Acta*. Dec2017, Vol. 257, p146-154. 9p. DOI: [10.1016/j.electacta.2017.10.072](https://doi.org/10.1016/j.electacta.2017.10.072).

X-ray powder diffraction data and characterization of Mirabegron. Quintana Mendoza, Jose H.; Henao, J. A.; Aparicio, Andrea P.; Romero Bohorquez, Arnold R. *Powder Diffraction*. Dec2017, Vol. 32 Issue 4, p290-294. 5p. DOI: [10.1017/S0885715617001129](https://doi.org/10.1017/S0885715617001129).

Strain and Compositional Analysis of (Si)Ge Fin Structures Using High Resolution X-Ray Diffraction. Schulze, Andreas; Loo, Roger; Witters, Liesbeth; Mertens, Hans; Gawlik, Andrzej; Horiguchi, Naoto; Collaert, Nadine; Wormington, Matthew; Ryan, Paul; Vandervorst, Wilfried; Caymax, Matty. *Physica Status Solidi (C)*. Dec2017, Vol. 14 Issue 12, pn/a-np. 7p. DOI: [10.1002/pssc.201700156](https://doi.org/10.1002/pssc.201700156).

The {110} reflection in X-ray diffraction of MXene films: Misinterpretation and measurement via non-standard orientation. Ghidoui, Michael; Barsoum, Michel W. *Journal of the American Ceramic Society*. Dec2017, Vol. 100 Issue 12, p5395-5399. 5p. 2 Graphs. DOI: [10.1111/jace.15124](https://doi.org/10.1111/jace.15124).

Hydration of MgO/SiO₂ and Portland cement mixtures: A structural investigation of the hydrated phases by means of X-ray diffraction and solid state NMR spectroscopy. Martini, Francesca; Tonelli, Monica; Geppi, Marco; Ridi, Francesca; Borsacchi, Silvia; Calucci, Lucia. *Cement & Concrete Research*. Dec2017, Vol. 102, p60-67. 8p. DOI: [10.1016/j.cemconres.2017.08.029](https://doi.org/10.1016/j.cemconres.2017.08.029).

Investigation of collective dynamics of solvent molecules in nanofluids by inelastic x-ray scattering. Yano, Kazuhisa; Yoshida, Koji; Kamazaki, Kazuya; Uchiyama, Hiroshi; Tsutsui, Satoshi; Baron, Alfred Q.R.; Fukushima, Yoshiaki; Yamaguchi, Toshio. *Journal of Molecular Liquids*. Dec2017, Vol. 248, p468-472. 5p. DOI: [10.1016/j.molliq.2017.09.079](https://doi.org/10.1016/j.molliq.2017.09.079).

Study of quasi-two- and three-dimensional ordered porous structures by means of small-angle x-ray scattering in the grazing incidence geometry. Dubitskiy, I.; Griogorova, N.; Misonov, A.; Valkovskiy, G.; Saopoleva, N.; Sapotelova, S. *Physics of the Solid State*. Dec2017, Vol. 59 Issue 12, p2464-2475. 12p. DOI: [10.1134/S1063783417120137](https://doi.org/10.1134/S1063783417120137).

The modular small-angle X-ray scattering data correction sequence. Pauw, B. R.; Smith, A. J.; Snow, T.; Terill, N. J.; Thünemann, A. F. *Journal of Applied Crystallography*. Dec2017, Vol. 50 Issue 6, p1800-1811. 11p. DOI: [10.1107/S1600576717015066](https://doi.org/10.1107/S1600576717015066).

Modeling the polarized X-ray scattering from periodic nanostructures with molecular anisotropy. Liman, Christopher D.; Germer, Thomas A.; Sunday, Daniel F.; Delongchamp, Dean M.; Kline, R. Joseph. *Journal of Applied Crystallography*. Dec2017, Vol. 50 Issue 6, p1677-1690. 13p. DOI: [10.1107/S160057671701408X](https://doi.org/10.1107/S160057671701408X).

Self-assembly of a binary mixture of iron oxide nanoparticles in Langmuir film: X-ray scattering study. Uklev, V.; Dudnik, M.; Dubitskiy, I.; Khassanov, A.; Snigireva, I.; Kononov, O.; Vorobieva, A. *Materials Chemistry & Physics*. Dec2017, Vol. 202, p31-39. 9p. DOI: [10.1016/j.matchemphys.2017.08.069](https://doi.org/10.1016/j.matchemphys.2017.08.069).

Spinel energy distributions in liquid water using a generalized oscillator strength from inelastic x-ray scattering measurements. Karamitros, Mathieu; Moczulder, Ansgar. *Radiation Physics & Chemistry*. Dec2017, Vol. 141, p378-384. 7p. DOI: [10.1016/j.radphyschem.2016.11.014](https://doi.org/10.1016/j.radphyschem.2016.11.014).