



橋 THE BRIDGE
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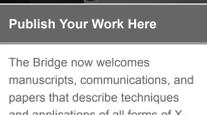
MiniFlex – qualitative and quantitative analysis of polycrystalline materials



Benchtop X-ray diffraction (XRD) instrument

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 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 email [copy](#) to the editor.

Versatile dual wavelength X-ray diffractometer with HPC X-ray detector



XtaLAB Synergy-DW

One source with two high-flux wavelengths is the foundation of the revolutionary XtaLAB Synergy-DW single crystal X-ray diffractometer. It combines the increased flux of a rotating anode X-ray source with the flexibility of two different wavelengths, making it ideal for laboratories exploring a wide range of research interests. **For more >**

Video of the Month



Science View – A New Magnesium Alloy Developed in Japan – Light, Strong, and Flame-Resistant!

In this program, Japanese scientists delve into the fascinating worlds of cutting-edge technology and the natural sciences. Innovators who contribute to manufacturing in Japan are also introduced. **Watch video >**

Conferences and Workshops



Join Rigaku at future meetings

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

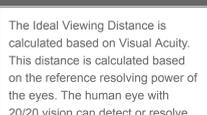
CBECIMAT – Congresso Brasileiro de Engenharia e Ciência dos Materiais
Foz do Iguaçu, Brazil
November 4 – 8, 2018

Geological Society of America (GSA 2018)
Indianapolis, IN, US
November 4 – 7, 2018

MRS Fall 2018
Boston, MA, US
November 25 – 30, 2018

See the complete list >

Useful Link of the Month



TV Monitor Viewing Distance Calculator

The ideal viewing distance is calculated based on Visual Acuity. This distance is calculated based on the reference resolving power of the eyes. The human eye with 20/20 vision can detect or resolve details as small as 1/60th of a degree of arc. This distance represents the point beyond which some details in the picture are no longer able to be resolved, so pixels begin to blend together. Closer to the screen than this may result in the need for a higher resolution display. **For more >**

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

For all who came to see us exhibit the latest in X-ray analytical instrumentation at SAS, MS&T and the GCC, we thank you. Everyone was happy to see many new faces come by and talk. Next month please come visit us at Geological Society of America booth #811 (Indianapolis, Nov. 4-7), the Eastern Analytical Symposium booth #M1 (Plainsboro, NJ, Nov. 12-14) and MRS Fall '18 booth #416 (Boston, Nov. 25-30). Finally, I encourage regional ACS members to attend ACS Southwest (SWRM) as it is in my home town of Little Rock, AR (Nov. 7-10) this year. A complete list of events may be found [here](#).

This month's issue contains two featured articles. The first article discusses the new SmartLab multipurpose diffractometer. The second paper discusses the life and research of Professor Frances H. Arnold, who was awarded the 2018 Nobel Prize in Chemistry.



Yamanashi factory and surrounding areas during autumn season.
Photos by Masayuki Watanabe, Rigaku Corporation.

This month's featured XRD technical note discusses texture analysis of a Cu wiring film using the Orientation Distribution Function (ODF). XRF application notes discuss the measurement of sulfur in petroleum by ASTM D2622-16 and the analysis of carbon black by EDXRF spectroscopy.

The book review covers *The Equations of Life: How Physics Shapes Evolution* by Charles S. Cockell. Check out the video covering how Japanese scientists delve into the fascinating worlds of cutting-edge technology. 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

SmartLab: Automated multipurpose X-ray diffractometer
Rigaku Corporation

SmartLab, which was announced as a thin film sample X-ray diffractometer in 2005, is a high-precision goniometer with a high-intensity X-ray source based on an innovative ergonomic design, and is widely used by many users. SmartLab has been updated several times in the 13 years since its launch. This year, an even more sophisticated model of SmartLab was introduced. **Full article >**

Featured Article

Professor Frances H. Arnold was awarded half of the 2018 Nobel Prize in Chemistry for the "directed evolution of enzymes"

Professor Arnold earned a PhD in Chemical Engineering in 1985 from the University of California at Berkeley, where she became interested in biological processes. After finishing her PhD, she moved to the California Institute of Technology as a visiting associate. She worked her way through the ranks and became a full professor in 1996. She has remained at CalTech and is currently the Linus Pauling Professor of Chemical Engineering, Bioengineering and Biochemistry. **Full article >**

XRD Application Note

Texture Analysis of a Cu Wiring Film using the Orientation Distribution Function (ODF)
Rigaku Corporation

Since there is a strong relation between the material characteristics and the crystal orientation of metals and many other industrial materials, quantitative analyses of crystallites orientation and their distributions are of great importance. Pole figure measurements are a common method to quantitatively analyze orientation. In this application note, we used the Orientation Distribution Function (ODF) to evaluate the crystallites orientation of a Cu wiring film from a pole figure measurement. **For more >**

WDXRF Application Note

Sulfur Analysis in Petroleum Products by WDXRF According to ASTM D2622-16
Rigaku Corporation

This application note demonstrates quantitative analysis of sulfur in petroleum products according to ASTM D2622-16 on Rigaku ZSX Primus, a wavelength dispersive X-ray fluorescence (WDXRF) spectrometer. **For more >**

EDXRF Application Note

Analysis of Carbon Black
Applied Rigaku Technologies

Carbon black is made from coal tar and various petroleum tars from the cracking process. Carbon black is a crystalline form of carbon with very high surface area to volume ratio and is used mainly as a reinforcing filler in tires and used to strengthen engine hoses and gear belts. It is also used as copier toner inks and as pigment in polymers. The elemental characterization of the carbon black is critical to ensure proper quality of the various products. **For more >**

Book Review

The Equations of Life: How Physics Shapes Evolution
By Charles S. Cockell

Charles S. Cockell's *The Equations of Life* does a phenomenal job of presenting evolution from a new perspective. Cockell, an astrobiologist at the University of Edinburgh, states in the short preface, "This book explores one line of thinking that tries to make sense of diverse areas of science that straddle the living and the nonliving, the indefeasible links between physics and evolutionary biology." *The Equations of Life* does just that, and does it quite well. **Read review >**

Material Analysis in the News

News for October 2018

October 1, 2018. Scientists from the Energy Materials and Surface Sciences Unit at the Okinawa Institute of Science and Technology Graduate University (OIST) believe they've found a winning formula in a [new method to fabricate low-cost high-efficiency solar cells](#). Prof. Yabing Qi and his team from OIST in collaboration with Prof. Shengzhong Liu from Shaanxi Normal University, China, developed the cells using the materials and compounds that mimic the crystalline structure of the naturally occurring mineral perovskite.

October 1, 2018. Scientists from University of Surrey joined forces with Johns Hopkins University in Baltimore and the University of California to develop a [material that has high stiffness and damping](#). The team achieved this near impossible combination in a material by using 3D woven technical textile composite sheets, with selected unbonded fibres.

October 5, 2018. The MASCOAT lander released from [Japan's Hayabusa 2 spacecraft](#) this week made three hops to different locations on asteroid Ryugu before draining its battery, outliving its design life and sending back data from all four of its instruments. The tiny lander was released from the Hayabusa 2 spacecraft as the Japanese mothership maneuvered to a point just 51 meters from Ryugu.

October 5, 2018. Northwestern University scientists have developed [soft materials that autonomously self-assemble](#) into molecular superstructures and remarkably disassemble on demand, changing the properties of materials and opening the door for novel materials in applications ranging from sensors and robotics to new drug delivery systems and tools for tissue regeneration.

October 9, 2018. Scientists led by Professor Kyosuke Yoshimi of Tohoku University, Japan, developed a [titanium carbide \(TiC\)-reinforced, molybdenum-silicon-boron \(Mo-Si-B\)-based alloy](#), or MoSiB/TiC, whose high-temperature strength was identified under constant forces in the temperature ranges of 1,400-1,600 degrees Celsius.

October 12, 2018. A team of researchers from Shinshu University in Nagano, Japan is now closer to a thin, [high-capacity lithium-ion battery](#) that could open the gates to better energy storage systems for electric vehicles. The research team was led by professor Katsuya Teshima, director of the Center for Energy and Environmental Science at Shinshu University in Japan.

October 16, 2018. A group of researchers centered at Osaka University has specifically tailored an electron-accepting unit that was then successfully used in an organic semiconductor applied in solar cell device that showed high photovoltaic performance. The [fluorinated electron-acceptor unit was used to prepare a thin film solar cell](#) that was compared with a cell based on a non-fluorinated analogue. The researchers found that the fluorinated material showed enhanced power conversion efficiency, up to 3.12%.

October 18, 2018. In a new study from the U.S. Department of Energy's (DOE) Argonne National Laboratory, scientists have identified a [new class of topological materials](#) by inserting transition metal atoms into the atomic lattice of niobium disulfide (NbS₂), a well-known two-dimensional material. They found that CoNb₃S₆, an antiferromagnetic material, exhibits an extremely large anomalous Hall effect, a sign of the topological character of materials.

October 20, 2018. European Space Agency and the Japan Aerospace Exploration Agency announced that the unmanned [BenCiColombo spacecraft](#) successfully separated and was sent into orbit from French Guiana as planned to begin a seven-year journey to Mercury.

October 25, 2018. An innovative filtering material may soon reduce the environmental cost of manufacturing plastic. The material, a [metal-organic framework](#), can extract ethylene, the key ingredient in the most common form of plastic, from a mixture of other chemicals – while consuming far less energy than usual.

October 25, 2018. A NIMS-Ehime University joint research team succeeded in discovering [new materials that exhibit superconductivity under high pressures](#) using materials informatics (MI) approaches (data science-based material search techniques). This study experimentally demonstrated that MI enables efficient exploration of new superconducting materials.

Recent Scientific Papers of Interest

Papers for October 2018

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

X-ray Constrained Spin-Coupled Wavefunction: a New Tool to Extract Chemical Information from X-ray Diffraction Data. Genoni, Alessandro; Franchini, Davide; Pieraccini, Stefano; Stroni, Maurizio. *Chemistry – A European Journal*, 10/17/2018, Vol. 24 Issue 58, p15507-15511. 5p. DOI: [10.1002/chem.201803988](#).

Multiscale wavelet decomposition of time-resolved X-ray diffraction signals in cyclohexadiene. Al. Ospiwo, Vladimir; Kowalewski, Markus; Mukamel, Shaul. *Proceedings of the National Academy of Sciences of the United States of America*, 10/9/2018, Vol. 115 Issue 41, p10269-10274. 6p. DOI: [10.1073/pnas.1811983115](#).

Dual conical shell illumination for volumetric high-energy X-ray diffraction imaging. Dicken, Anthony; Spence, Daniel; Rogers, Keith; Prokopiou, Danae; Evans, Paul. *Analyst*, 10/21/2018, Vol. 143 Issue 20, p4849-4853. 5p. DOI: [10.1039/c8an01537f](#).

Inflexible stoichiometry in bulk pyrite FeS₂ as viewed by in situ and high-resolution X-ray diffraction. McAuliffe, Rebecca D.; Shoemaker, Daniel P. *Acta Crystallographica: Section B, Structural Science, Crystal Engineering & Materials*, Oct2018, Vol. 74 Issue 5, p436-444. 9p. DOI: [10.1107/S2052520618010144](#).

Operando powder X-ray diffraction study of P2-Na_xNi_{0.3}Mn_{0.7}O₂ cathode material during electrochemical cycling. Kjeldgaard, Solvejg; Birgisson, Steinar; Kjeliland, Anette Gert; Iversen, Bo Brummerstedt. *Journal of Applied Crystallography*, Oct2018, Vol. 51 Issue 5, p1304-1310. 6p. DOI: [10.1107/S1600576718010531](#).

Technical Note: A benchtop cone-beam x-ray fluorescence computed tomography (XFCT) system with a high-power x-ray source and transmission CT imaging capability. Manohar, Nivedh; Reynoso, Francisco J.; Cho, Sang Hyun. *Medical Physics*, Oct2018, Vol. 45 Issue 10, p4652-4659. 8p. DOI: [10.1002/mp.13138](#).

Analysis of recrystallization behavior of shot peened graphene reinforced Al composites during isothermal annealing by X-ray diffraction method. Zhan, Ke; Wu, Yihao; Li, Jiongli; Zhao, Bin; Yan, Ya; Wang, Lianbo. *Journal of Alloys & Compounds*, Oct2018, Vol. 765, p862-868. 7p. DOI: [10.1016/j.jallcom.2018.06.269](#).

Reactions of antimony compounds with fluorine gas by thermogravimetric and differential thermal analyses and X-ray diffraction analysis. Watanabe, Daisuke; Akiyama, Daisuke; Sato, Nobuaki. *Journal of Fluorine Chemistry*, Oct2018, Vol. 214, p1-7. 7p. DOI: [10.1016/j.fluchem.2018.07.009](#).

Calibration and detection limits of homemade ED-XRF system in the analysis of silver-copper alloys. Gójska, Aneta Maria; Mista-Jakubowska, Ewelina Agnieszka. *Nuclear Instruments & Methods in Physics Research Section B*, Oct2018, Vol. 433, p28-33. 6p. DOI: [10.1016/j.nimb.2018.07.026](#).

Investigation of color layers of Bohemian panel paintings by confocal micro-XRF analysis. Prokeš, Radek; Antušková, Václava; Šefců, Radka; Trojek, Tomáš; Chlumská, Štěpánka; Cechák, Tomáš. *Radiation Physics & Chemistry*, Oct2018, Vol. 151, p59-64. 6p. DOI: [10.1016/j.radphyschem.2018.05.006](#).

Unravelling the structural properties of mixed-valence α- and β-AuSe nanostructures using XRD, TEM and XPS. Machogo, Lerato F.E.; Telyana, Phumlini; Sithole, Rudo; Gqoba, Sizwe S.; Phao, Neo; Airo, Mildred; Shumbula, Poslet M.; Moloto, Makwena J.; Joloto, Nospo. *Applied Surface Science*, Oct2018, Vol. 456, p973-979. 7p. DOI: [10.1016/j.apsusc.2018.06.141](#).

Computer-aided assembly of X-ray parabolic cylinder laterally graded multilayer reflector to collimate divergent beam in XRD. Yao, Yiyun; Zhang, Zhong; Yi, Shengzhen; Zhang, Zhe; Xie, Chun. *Nuclear Instruments & Methods in Physics Research Section A*, Oct2018, Vol. 906, p22-29. 8p. DOI: [10.1016/j.nima.2018.07.052](#).

Alteration of fine fraction of bentonite from Kopenica (Slovakia) under acid treatment: A combined XRD, FTIR, MAS NMR and AES study. Pentrák, Martin; Hronský, Viktor; Pálková, Helena; Uhlík, Peter; Komadel, Peter; Madejová, Jana. *Applied Clay Science*, Oct2018, Vol. 163, p204-213. 10p. DOI: [10.1016/j.clay.2018.07.028](#).

Examination and analysis of Indian silver punch-marked coins employing WD-XRF and other noninvasive techniques. Mamania, Divija; Singh, M. R.; Lal, U. S. *Surface & Interface Analysis: SIA*, Oct2018, Vol. 50 Issue 10, p947-953. 7p. DOI: [10.1002/sia.6511](#).

X-ray computed tomography (XCT) and chemical analysis (EDX and XRF) used in conjunction for cultural conservation: the case of the earliest scientifically described dinosaur *Megalosaurus bucklandii*. Wilson, P. F.; Smith, M. P.; Hay, J.; Warnett, J. M.; Attridge, A.; Williams, M. A. *Heritage Science*, 10/3/2018, Vol. 6 Issue 1, p1-1. 1p. DOI: [10.1186/s40494-018-0223-0](#).

In-situ high temperature X-ray diffraction study of dickite. Yan, Yu; Wang, Hejing. *Applied Clay Science*, Oct2018, Vol. 163, p137-145. 9p. DOI: [10.1016/j.clay.2018.07.021](#).

Analytical capabilities of Energy Dispersive X-Ray Fluorescence for the direct quantification of iron in cocoa powder and powdered cocoa drink. Andrey, D.; Duffier, J.P.; Perring, L. *Spectrochimica Acta Part B*, Oct2018, Vol. 148, p137-142. 6p. DOI: [10.1016/j.sab.2018.06.014](#).

Total reflection X-ray diffraction study of beef: mechanically separated meat from non-mechanically separated meat. Dalipi, R.; Berneri, R.; Curatolo, M.; Borgese, L.; Depero, L.E.; Sangiorgi, E. *Spectrochimica Acta Part B*, Oct2018, Vol. 148, p116-122. 7p. DOI: [10.1016/j.sab.2018.06.002](#).

Evaluation of total-reflection X-ray fluorescence measurements for the prospective determination of uranium in the decommissioning of the Fukushima Daiichi Nuclear Power Plant reactor. Yoshii, Hiroshi; Izumoto, Yukie; Matsuyama, Tsugufumi; Ishii, Kota; Sakai, Yasuhiro. *Spectrochimica Acta Part B*, Oct2018, Vol. 148, p183-187. 5p. DOI: [10.1016/j.sab.2018.07.004](#).

Analysis of organic multilayer structures using a combined grazing incidence X-ray fluorescence/X-ray reflectometry approach. Maddern, Christof; Ingerle, Dieter; Bretschneider, Thomas; Rauwolf, Mirjam; Lument, Christoph; Buchholz, Herwig; Borchert, Holger; Strelli, Christina; Parisi, Jürgen. *Spectrochimica Acta Part B*, Oct2018, Vol. 148, p188-192. 5p. DOI: [10.1016/j.sab.2018.07.006](#).

Evaluation of high resolution X-ray monochromator wavelength dispersive X-ray fluorescence instrument for determining Pu and U in nuclear reprocessing streams. McIntosh, K.G.; Davilla, G.J.; Gilmore, R.F.; Holland, M.K. *Spectrochimica Acta Part B*, Oct2018, Vol. 148, p1-7. 7p. DOI: [10.1016/j.sab.2018.04.019](#).

Determination of Mercury(II) in Drinking Water by Total Reflection X-ray Fluorescence Spectrometry and Liquid-Liquid Microextraction. Koskolok, Kirill V.; Monogarov, Oksana V.; Alov, Nikolai V. *Analytical Letters*, 2018, Vol. 51 Issue 15, p2457-2467. 11p. 1 Diagram, 4 Charts, 4 Graphs. DOI: [10.1080/00032719.2017.1423078](#).

Near-infrared spectroscopy and X-ray fluorescence data fusion for olive leaf analysis and crop nutritional status determination. Comino, F.; Ayora-Cañada, M.J.; Aranda, V.; Diaz, A.; Dominguez-Vidal, A. *Talanta*, Oct2018, Vol. 188, p676-684. 9p. DOI: [10.1016/j.talanta.2018.06.058](#).