Rigaku
Leading With Innovation

X-ray Diffraction & Elemental Analysis

Welcome

Thanks again to everyone who came by our booths at the thirteen conferences we attended this month. In July, we invite you to visit the various Rigaku divisions attending a variety of events scattered around the globe. There is a link to a complete list of upcoming conferences below.

This month's issue contains a *Rigaku Journal* article describing the principles and applications of multilayer mirror optics for X-ray diffraction measurements as used in the Rigaku SmartLab. Also for XRD users, we offer an application note describing quantitative analysis of a non-crystalline (amorphous) phase.

Rigaku joined Thailand Institute of Science and Technological Research (TISTR)'s From Local to Global International Forum: Food Industry 4.0

As illustrated in the above pictures, Rigaku joined Thailand Institute of Science and Technological Research (TISTR)'s From Local to Global International Forum: Food Industry 4.0 in Bangkok, Thailand on June 12 – 13, 2017. Since Rigaku uniquely offers a differential scanning calorimetry (DSC) attachment for simultaneous measurement with XRD on the SmartLab system, we delivered a talk on the use of this technology for Halal food analysis. There was considerable interest in this technology as theThai Science and Technology minister visited our booth.

Application papers are also included for TXRF, WDXRF and EDXRF techniques, with the WDXRF AppNote highlighting the analysis of phosphorous, sulfur and chlorine in liquids with the Rigaku Supermini200. The book review this month concerns *Not a Scientist: How Politicians Mistake, Misrepresent, and Utterly Mangle Science* by David Levitan. This month's video is about driving around on the lunar surface. Check out the news and papers sections at the bottom of the page for the latest developments in materials science.

Enjoy the newsletter.

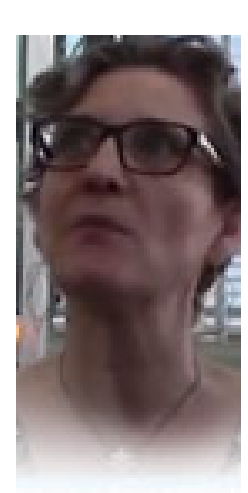
R.C. Tisdale, Ph.D. – Editor

Featured Rigaku Journal Article

Principles and applications of multilayer mirror optics for X-ray diffraction measurements — CBO series for SmartLab

By Takeshi Osakabe, Rigaku Corporation

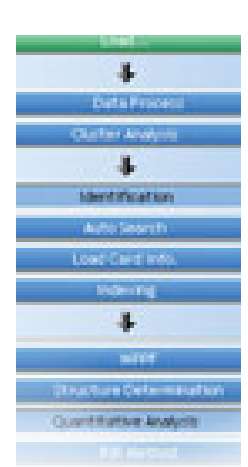
Rigaku has developed and patented a CBO (Cross Beam Optics) unit that can switch a BB optic and a PB optic using a parabolic multilayer mirror by simply changing the selection slit. Subsequently, the "CBO-E" unit, which has a multilayer mirror forming a convergent beam, was marketed to accommodate diverse measurement needs. **Full article >**



Featured Interview

Professor Alexandra M Z Slawin

Professor Slawin is the Director of the Molecular Structure Laboratory and Professor of Chemical Crystallography at the University of St. Andrews. Alex is one of the most prolific crystallographers in the world in terms of depositions to the Cambridge Structural Database. Alex has at her disposal a Mo FR-X rotating anode with Osmic optics and two Pilatus HPCs, a Cu MM007HF with Osmic optics and two more Pilatus HPCs, an SCXmini for teaching crystallography and an ACTOR automated small molecule data collection system. Among Alex's collaborators is Fraser Stoddart, one of 2016's Chemistry Nobel Laureates. **Watch video >**



Application of Integrated X-ray Powder Diffraction Software: PDXL

Quantitative analysis of a non-crystalline (amorphous) phase

Amorphous materials have attracted a lot of attentions from many researchers in the materials science field. In a mixture of crystalline and amorphous materials, the amorphous phase is sometimes preferable, but sometimes not. It is very important to know the weight fraction of the amorphous phase in a target material, and the X-ray diffraction technique is one of the best to analyze the amorphous quantity in a sample. Below are described three quantitative analysis methods of an amorphous phase that are available in PDXL. **For more >**

TXRF Application Note

Benchtop TXRF spectrometer NANOHUNTER II Gas Flush Mechanism

Rigaku Corporation

An incident X-ray beam impinges upon the sample at a shallow angle resulting in virtually complete reflection of the excitation beam away from the silicon drift detector. This affords dramatically reduced background contributions in the measured energy dispersive X-ray fluorescence spectra. The fast and easy operation is provided under air atmosphere and with gas flush mechanism. **For more >**

WDXRF Application Note

Ultra Low P, S, Cl Analysis in Liquids with a Benchtop WDXRF Spectrometer

Rigaku Corporation

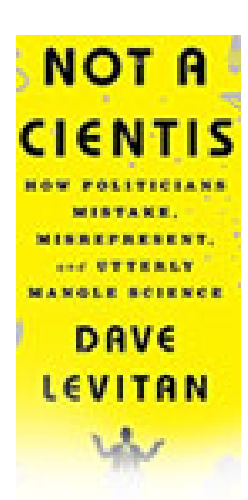
Phosphorous, sulfur and chlorine are commonly analyzed elements in liquids such as petroleum products and organic solvents. For example, phosphorous is added to lubricating oils to prevent wear of gears under high pressure. Sulfur content in automotive fuel oils are regulated by the US environmental protection agency (EPA) and directives such as EURO VI to minimize air pollution due to automotive vehicles. Chlorine, contained for example in crude oil, is an unwanted element known for corroding oil processing installations and liquid transmission pipelines. **For more >**

EDXRF Application Note

Lead-free Solder

Applied Rigaku Technologies

Lead content (Pb) is limited in most solder applications according to regulations RoHS, WEEE and ELV initiatives. These regulations limit the maximum allowable Pb in solder to no greater than 0.1000% Pb (1000 ppm). Energy Dispersive X-ray Fluorescence (EDXRF) is an accepted analysis technique for the rapid screening to determine whether Pb is below allowable limits. Fast and simple to operate, the NEX DE VS system offers screening for Pb content and use of camera view and automatic small spot collimators down to 1mm spot size, making it an ideal tool for rapid screening to ensure regulation compliance. **For more >**



Book Review

Not a Scientist: How Politicians Mistake, Misrepresent, and Utterly Mangle Science

By David Levitan

This is another book I learned about on Science Friday. The author is a science journalist whose credentials include a Master's in journalism from NYU and published articles in periodicals like *Scientific American* and *Time*. **Full review >**

Material Analysis in the News

News for June 2017

June 1, 2017. There is a new race to the moon, and it is the private sector — not governments — that is providing the runners. And unlike last time, Japan is in the thick of the action. If all goes as planned, a Japanese rover will soon be cruising across the lunar landscape for the first time ever.

June 2, 2017. Dr. Elton Santos from Queen's University's School of Mathematics and Physics has been working with a team of top-notch scientists from Stanford University, University of California, California State University and the National Institute for Materials Science in Japan to create new dynamic hybrid devices that are able to conduct electricity at unprecedented speeds and are light, durable and easy to manufacture in large scale semiconductor plants. The discovery could end cracked smart devices.

June 2, 2017. In a new study, a team of researchers from Japan has demonstrated that the ultrafast, chaotic oscillatory dynamics in lasers makes these devices capable of decision making and reinforcement learning, which is one of the major components of machine learning. To the best of the researchers' knowledge, this is the first demonstration of ultrafast photonic decision making or reinforcement learning, and it opens the doors to future research on "photonic intelligence."

June 8, 2017. The world's most powerful X-ray laser beam creates a "molecular black hole." When the X-rays blast electrons out of one atom, stripping it from the inside out, it steals more from its neighbors — a new insight that could help advance high-resolution imaging of whole viruses, bacteria and complex materials.

June 13, 2017. In an attempt to develop new mechanochromic compounds, a research group at Hokkaido University in Japan found a gold compound called 9-anthryl gold(I) isocyanide complex that has a unique feature. It can dramatically change its color from fluorescent blue to invisible infrared when ground.

June 19, 2017. Materials scientists at the U.S. Department of Energy's Argonne National Laboratory have identified the trilayer nickelate compound $Pr_4Ni_3O_8$ as a promising candidate material for high-temperature superconductivity.

June 20, 2017. An international team led by scientists from the Department of Energy's SLAC National Accelerator Laboratory and Stanford University has detected new features in the electronic behavior of a copper oxide material that may help explain why it becomes a superconductor at relatively high temperatures.

June 24, 2017. Japan generates about 800 billion kilowatt-hours of electricity every year to power homes and businesses. However, 5 percent of this, or 40 billion kilowatt-hours, is lost in the form of heat, for reasons such as electrical resistance in power lines. If superconductive power lines could be created, it would greatly cut down on the amount of electricity lost.

Recent Scientific Papers of Interest

Papers for June 2017

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

Processing two-dimensional X-ray diffraction and small-angle scattering data in *DAWN 2*. Filik, J.; Ashton, A. W.; Chang, P. C. Y.; Chater, P. A.; Day, S. J.; Drakopoulos, M.; Gerring, M. W.; Hart, M. L.; Magdysyuk, O. V.; Michalik, S.; Smith, A.; Tang, C. C.; Terrill, N. J.; Wharmby, M. T.; Wilhelm, H. Journal of Applied Crystallography. Jun2017, Vol. 50 Issue 3, p959-966. 7p. DOI: 10.1107/S1600576717004708.

Intercalated water in multi-layered graphene oxide paper: an X-ray scattering study. Rouzière, Stéphan; Núñez, J. David; Paineau, Erwan; Benito, Ana M.; Maser, Wolfgang K.; Launois, Pascale. Journal of Applied Crystallography. Jun2017, Vol. 50 Issue 3, p876-884. 8p. DOI: 10.1107/S1600576717006227.

Optimization and Characterization of Cobalt & Gadolinium films using X-Ray scattering. Basha, M. A.; Prajapat, C. L.; Singh, Surendra; Basu, S. AIP Conference Proceedings. 2017, Vol. 1832 Issue 1, p1-3. 3p. 2 Charts, 4 Graphs. DOI: 10.1063/1.4980511.

Determination of K shell XRF Parameters and K to L shell Vacancy Transfer Probabilities of Ferromagnetic 3d Transition Metals. Alim, Bünyamin; Ugurlu, Mine; Han, Ibrahim; Demir, Lütfü. AIP Conference Proceedings. 2017, Vol. 1833, p1-5. 5p. 1 Chart, 3 Graphs. DOI: 10.1063/1.4981733.

Selenium enriched dietary supplement rapid screening method using XRF and DART-HRAM-MS for label verification. Hanley, T. A.; Kubachka, K.; Taylor, A. M.; Kern, S. E. JAAS (Journal of Analytical Atomic Spectrometry). Jun2017, Vol. 32 Issue 6, p1196-1202. 7p. DOI: 10.1039/c7ja00050b.

An *in situ* USAXS-SAXS-WAXS study of precipitate size distribution evolution in a model Ni-based alloy. Andrews, Ross N.; Serio, Joseph; Muralidharan, Govindarajan; Ilavsky, Jan. Journal of Applied Crystallography. Jun2017, Vol. 50 Issue 3, p734-740. 6p. DOI: 10.1107/S1600576717006446.

XRF analysis to identify historical photographic processes: The case of some Interguglielmi Jr.'s images from the Palermo Municipal Archive. Modica, A.; Alberghina, M.F.; Brai, M.; Bruno, M.; Di Bella, M.; Fontana, D.; Tranchina, L. Radiation Physics & Chemistry. Jun2017, Vol. 135, p76-80. 5p. DOI: 10.1016/j.radphyschem.2017.02.026.

XRD and FTIR study of the effect of Ultra High Molecular Weight Polyethylene (UHMWPE) as Binder on Kaolin Geopolymer Ceramics. Ahmad, R.; Bakri Abdullah, Mohd Mustafa Al; Hussin, K.; Sandu, A. V. AIP Conference Proceedings. 2017, Vol. 1835 Issue 1, p1-6. 6p. 3 Charts, 3 Graphs. DOI: 10.1063/1.4981852.

Identification of a deleterious phase in photocatalyst based on $Cd_{1-x}Zn_xS/Zn(OH)_2$ by simulated XRD patterns. Cherepanova, Svetlana; Markovskaya, Dina; Kozlova, Ekaterina. Acta Crystallographica: Section B, Structural Science, Crystal Engineering & Materials. Jun2017, Vol. 73 Issue 3, p360-368. 8p. DOI: 10.1107/S2052520617001664.

Structural, electronic and optical properties of monoclinic $Na_2Ti_3O_7$ from density functional theory calculations: A comparison with XRD and optical absorption measurements. Araújo-Filho, Adailton A.; Silva, Fábio L.R.; Righi, Ariete; da Silva, Maurícélio B.; Silva, Bruno P.; Caetano, Ewerton W.S.; Freire, Valder N. Journal of Solid State Chemistry. Jun2017, Vol. 250, p68-74. 7p. DOI: 10.1016/j.jssc.2017.03.017.

Establishment of institutional diagnostic reference level for computed tomography with automated dose-tracking software. Liang, Chong R.; Chen, Priscilla X. H.; Kapur, Jeevesh; Ong, Michael K. L.; Quek, Swee T.; Kapur, Subhash C. Journal of Medical Radiation Sciences. Jun2017, Vol. 64 Issue 2, p82-89. 8p. DOI: 10.1002/jmrs.210.

Comparison between non-invasive methods used on paintings by Goya and his contemporaries: hyperspectral imaging vs. point-by-point spectroscopic analysis. Daniel, Floréal; Mounier, Aurélie; Pérez-Arantegui, Josefina; Pardos, Carlos; Prieto-Taboada, Nagore; Fdez-Ortiz de Vallejuelo, Silvia; Castro, Kepa. Analytical & Bioanalytical Chemistry. Jun2017, Vol. 409 Issue 16, p4047-4056. 10p. DOI: 10.1007/s00216-017-0351-5.

Analytical requirements for quantitative X-ray fluorescence nano-imaging of metal traces in solid samples. Lemelle, Laurence; Simionovici, Alexandre; Schoonjans, Tom; Tucoulou, Rémi; Enrico, Emanuele; Salomé, Murielle; Hofmann, Axel; Cavalazzi, Barbara. Trends in Analytical Chemistry: TRAC. Jun2017, Vol. 91, p104-111. 8p. DOI: 10.1016/j.trac.2017.03.008.

Simulation and application of micro X-ray fluorescence based on an ellipsoidal capillary. Yang, Jing; Li, Yude; Wang, Xingyi; Zhang, Xiaoyun; Lin, Xiaoyan. Nuclear Instruments & Methods in Physics Research Section B. Jun2017, Vol. 401, p25-28. 4p. DOI: 10.1016/j.nimb.2017.02.018.

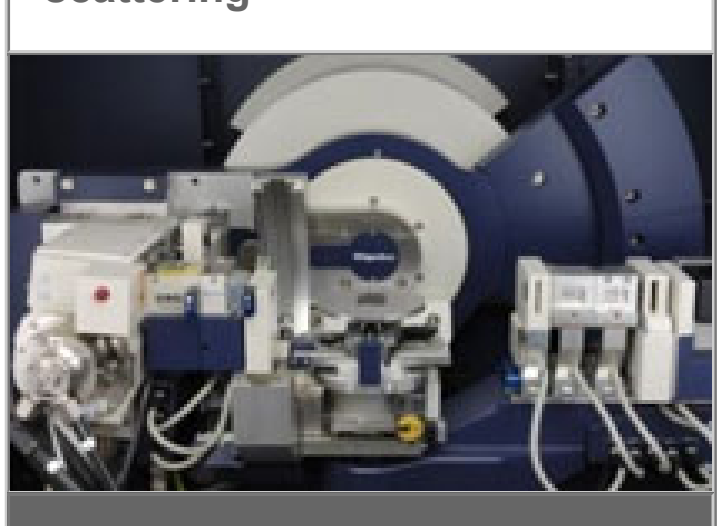
Depth Resolved Composition Analysis by Angle Dependent X-Ray Fluorescence Measurement. Srivastava, Himanshu; Khooha, Ajay; Singh, Ajit; Ganguli, Tapas. AIP Conference Proceedings. 2017, Vol. 1832 Issue 1, p1-3. 3p. 3 Graphs. DOI: 10.1063/1.4980529.

Influence of Fullerene Acceptor on the Performance, Microstructure, and Photophysics of Low Bandgap Polymer Solar Cells. Huang, Wenchao; Gann, Eliot; Chandrasekaran, Naresh; Prasad, Shyamal K. K.; Chang, Sheng-Yung; Thomsen, Lars; Kabra, Dinesh; Hodgkiss, Justin M.; Cheng, Yi-Bing; Yang, Yang; McNeill, Christopher R. Advanced Energy Materials. 6/7/2017, Vol. 7 Issue 11, pn/a-n/a. 10p. DOI: 10.1002/aenm.201602197.

***SLADS*: a parallel code for direct simulations of scattering of large anisotropic dense nanoparticle systems.** Chen, Sen; E, Juncheng; Luo, Sheng-Nian. Journal of Applied Crystallography. Jun2017, Vol. 50 Issue 3, p951-958. 7p. DOI: 10.1107/S1600576717004162.

Robust X-ray angular correlations for the study of meso-structures. Lhermitte, Julien R.; Tian, Cheng; Stein, Aaron; Rahman, Atikur; Zhang, Yugang; Wiegart, Lutz; Fluerasu, Andrei; Gang, Oleg; Yager, Kevin G. Journal of Applied Crystallography. Jun2017, Vol. 50 Issue 3, p805-819. 14p. DOI: 10.1107/S1600576717003946.

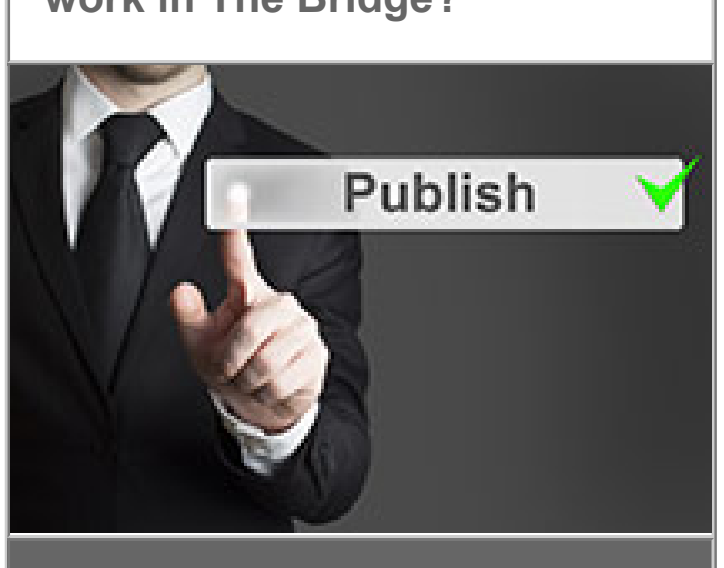
Powder diffraction, thin film diffraction, SAXS, in-plane scattering



SmartLab®

The SmartLab is the most novel high-resolution X-ray diffractometer available today. Perhaps its most novel feature is the SmartLab Guidance software, which provides you with an intelligent interface that guides you through the intricacies of each experiment. It is like having an expert standing by your side. **For more >**

Interested in publishing your work in The Bridge?



Publish Your Work Here

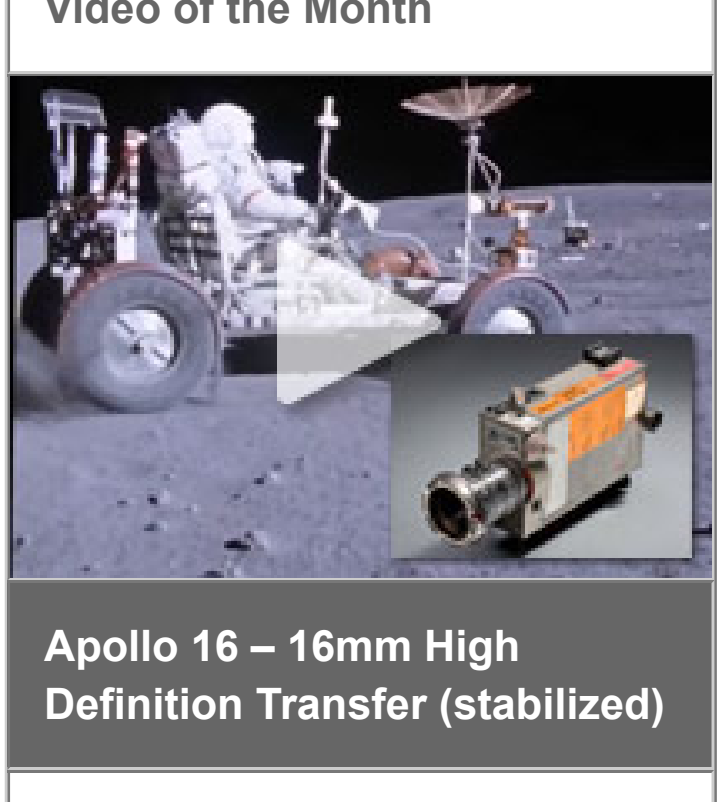
The Bridge now welcomes manuscripts, communications, and papers that describe techniques and applications of all forms of X-ray fluorescence (XRF) and X-ray diffraction (XRD, including SAXS) that are of interest to fellow scientists in industry, academia, and government. Manuscripts, in PDF format, are 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

High-contrast, high-resolution computed micro-tomography

nano3DX

Rigaku has developed the nano3DX as a high-resolution 3D X-ray microscope that combines Rigaku's unique high-brightness rotating anode X-ray generator with a proprietary high-resolution CCD X-ray camera to provide high-contrast computed tomography at the submicron level. The nano3DX is able to observe an ultra-wide field-of-view while retaining high 2D/3D spatial resolution and providing improved density resolution compared to conventional X-ray microscopes. **For more >**

Video of the Month



Apollo 16 – 16mm High Definition Transfer (stabilized)

Apollo 15 – 17 lunar missions deployed a J. A. Maurer 16 mm Data Acquisition Camera (DAC) which could run at frame rates between one and 24 frames per second. They recorded undocking of the spacecraft, the lunar descent, operations on the surface, and engineering data. The cameras carried film in magazines, each magazine containing 130 feet of color film. This high-definition video was stabilized in post production and presents a unique view of driving a car on the lunar surface. **Watch video >**

Conferences and Workshops

Join Rigaku at future meetings

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

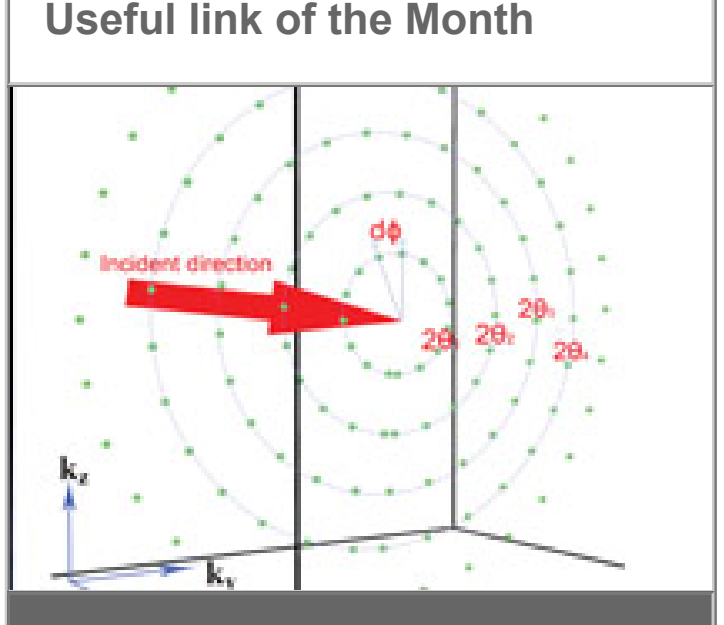
Interpol World 2017
Singapore
July 5 – 7, 2017

SEMICON West 2017
San Francisco, CA, USA
July 11 – 13, 2017

Aluminium China
Shanghai, China
July 19 – 21, 2017

See the complete list >

Useful link of the Month



SLADS: A parallel code for direct simulations of scattering of large, anisotropic, dense, nanoparticle systems

The Peac Institute of Multiscale Sciences
111, 1st Section,
Northern 2nd Ring Road
Chengdu, 610031
China

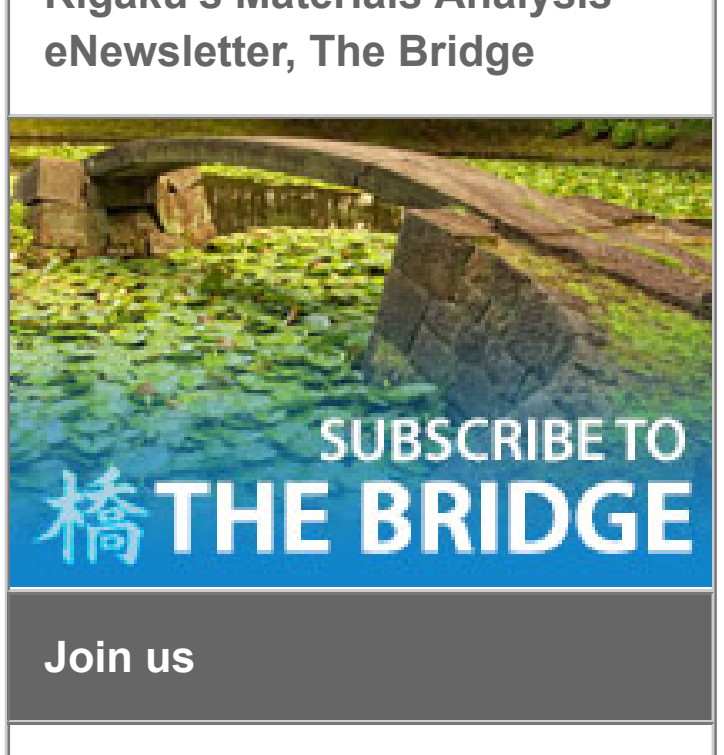
SLADS is a parallel code for direct simulations of X-ray **S**cattering of **L**arge, **A**nisotropic, **D**ense, nanoparticle **S**ystems of arbitrary species and atomic configurations. Particles can be of arbitrary shapes and dispersities, and interactions between particles are considered. Parallelization is achieved in real space for the sake of memory limitation. **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 >**