

### 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 >**

### Interested in publishing your work in The Bridge?

## Welcome

In case you missed it, Rigaku and Merck KGaA, Darmstadt, Germany, have formed a partnership to develop novel molecular structure analysis technology. As announced in a [June 6th press release](#), the collaboration involves the development of commercially available lab solutions employing highly innovative crystalline sponge technology.

July is another busy month for Rigaku with about 10 events planned around the globe. Just to highlight a few, we will be at Microscience Microscopy Congress (Manchester, UK), INTERPHEX (Tokyo, JP, Booth A19-33), SEMICON West (San Francisco, CA, Booth 746) and the American Crystallographic Association's annual meeting (Covington, KY, Booth 206/208). A complete list of all upcoming events can be found [here](#).

In case you are attending the 18th International Conference on Total Reflection X-ray Fluorescence Analysis and Related Methods (TXRF-2019), from 25-28 June at the University of Girona, Spain, please come and see the NANOHUNTER II workshop on Tuesday, June 26th at 14:30 hours. Note that a new TXRF AppNote, regarding analysis of As, Pb, and Cd in elute from tea, is featured below.

The featured *Rigaku Journal* article this month discusses determination of molecular structure of odor components based on crystalline sponge method. This month's featured event report covers Rigaku X-ray Microscopy Seminar and Workshop hosted by The Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Our WDXRF brief describes analysis of hazardous heavy elements in soil and sediment while the EDXRF brief details analysis of alloy powders.

The book review covers *The Universe Speaks in Numbers* by Graham Farmelo. Check out the interesting symposium video about the Nuclear Science Research Institute (NSRI) at the Japan Atomic Energy Agency (JAEA). 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

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### Featured Rigaku Journal Article

*Determination of molecular structure of odor components based on crystalline sponge method*

*Rigaku Corporation*

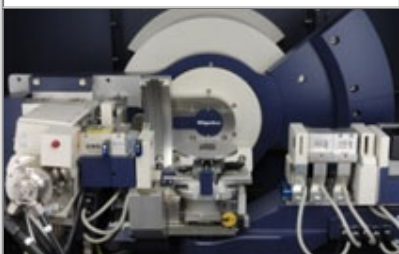
This report introduces examples of our attempts to analyze the structure of odor components, in which volatile substances emitted from natural products are directly trapped without the isolation of odor components or sample preparation, using the



## 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.

## 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 >**

“crystalline sponge method”, a single crystal X-ray structure analysis method that does not require sample crystallization. **Full article >**



## Featured Rigaku Event

### Rigaku X-ray Microscopy Seminar and Workshop

Reported by Aya Takase, Senior Scientist at Rigaku Americas Corporation

X-ray microscopy is a non-destructive 3D imaging technique and has become one of the most useful tools in materials science and medicine in recent years. As a leading X-ray company, Rigaku started an X-ray CT outreach to Materials and Life Science researchers last year. In 2018, a seminar and workshop was held at the University of Southern California Medical Imaging Center. On June 6, 2019, Rigaku held an X-ray Microscopy Seminar and Workshop hosted by The Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. **Full details >**



## TXRF Application Note

### Analysis of As, Pb, and Cd in Elute from Tea

Rigaku Corporation

Hazardous metallic elements from the soil accumulating in tea leaves is a health concern for people in Japan and Europe, where a large amount of tea leaves are imported and consumed. In the total reflection X-ray fluorescence (TXRF) method, sample preparation is easy: an aliquot of liquid is simply pipetted onto a carrier. Multi-elements quantification is available using the internal standard method without the need to prepare calibration curves. This note describes the analysis of hazardous elements such of As, Pb and Cd in the elute from tea leaves.

**For more >**



## WDXRF Application Note

### Analysis of Hazardous Heavy Elements in Soil and Sediment

Rigaku Corporation

Soil and sediment have a crucial role in our life as the foundation for agricultural crops and forests, and also by retaining water. When soil is polluted, it negatively impacts the ecosystem. Consequently, our health and the living environment suffer negative effects when we consume ground water and crops from polluted soil. To keep the environment clean, it is necessary to monitor soil and sediment. For analysis of hazardous heavy elements in soil and sediment, XRF spectrometry is used because of its simple sample preparation and short analysis time. **For more >**



## EDXRF Application Note

### Analysis of Alloy Powders for Metal 3D Printing

Applied Rigaku Technologies

The DMLS (Direct Metal Laser Sintering) process is used for prototyping metal parts and low volume manufacturing, eliminating expensive and time-consuming tooling. When mixing various metal alloy powders, it is important to monitor the elemental compositions of the raw materials and powder mixtures to ensure proper alloy balances for the parts being produced. The NEX CG EDXRF spectrometer offers a fast and simple analysis of metal alloy powders used in metal 3D printing.

**For more >**

## Video of the Month



## Nuclear Science Research Institute (NSRI) at the Japan Atomic Energy Agency (JAEA)

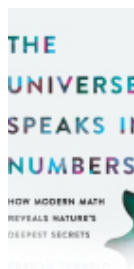
The NSRI is one of the main research institutes of JAEA and the core of research and development of nuclear science and technology. The NSRI has various research facilities for nuclear science and technology, such as research reactors, accelerators and dedicated facilities for radioisotopes and nuclear fuel materials. Furthermore, the Japan Proton Accelerator Research Complex (J-PARC), jointly managed by JAEA and the High Energy Accelerator Research Organization (KEK), is co-located in the site. Research and development are conducted in the areas of basic and fundamental nuclear science and technology to support nuclear energy utilization and to develop quantum beam applications of neutron and synchrotron radiation to materials science and actinide chemistry.

**For more >**

## Conferences and Workshops



**Join Rigaku  
at future meetings**

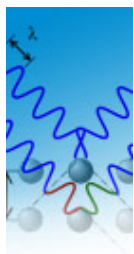


## Book Review

### *The Universe Speaks in Numbers*

By Graham Farmelo

In *The Universe Speaks in Numbers*, Graham Farmelo presents a concise version of the history of the relationship between mathematics and physics. As Farmelo explains in his book, the relationship, though perhaps a natural one, has not always been an easy one. He even goes so far as to describe it as one that has gone through a long divorce and subsequent reconciliation. **Read review >**



## Material Analysis in the News

### *News for June 2019*

**June 1, 2019.** Materials such as tungsten diselenide (WSe<sub>2</sub>) and molybdenum diselenide are being studied keenly for their opto-electronic properties – a combination of optics and electronics. A key property of these materials is photoluminescence, in which the material absorbs light and re-emits it as a spectrum. Researchers from IIT Madras have found a way of [enhancing this property about 30 times in tungsten diselenide](#) by drop-casting gold nanoparticles on to a two-dimensional film.

**June 2, 2019.** The cataclysmic [collision that created the Moon brought water to the Earth](#), allowing life to develop, according to planetologists at the University of Münster, Germany. The Moon was created 4.4 billion years ago when the Earth collided with a Mars-sized body named Theia. While a large amount of the resulting debris coalesced to form our Moon, some of the material fell to Earth and became part of the mantle, the rocky layer that surrounds the core.

**June 3, 2019.** 3D printing technology known as Laser Powder Bed Fusion (LPBF) additive manufacturing is becoming popular for manufacturing high-end specialized metal components. In order to fabricate parts with low porosity, controlled microstructure and low residual stress, it is fundamentally [important to understand and control the thermal history during the LPBF process](#).

**June 4, 2019.** A team of scientists from the Science Foundation Ireland centre for Advanced Materials and Bioengineering Research (AMBER) and the CRANN Institute is hoping to [make the work of many industries in materials science significantly easier](#). The team revealed it has developed a new method to model the atomic world using artificial intelligence (AI).

**June 6, 2019.** Scientists, led by Keiji Mori, Ph.D., Associate Professor at the Department of Applied Chemistry, Graduate School of Engineering, Tokyo University of Agriculture and Technology, have developed an efficient synthetic way to make organic molecules that have so far been difficult to synthesize because of their overall bulky structure and general instability. The final goal of the project is the [synthesis of various spiro \(or twisted-shaped\) compounds](#) that have a variety of different atoms.

**June 7, 2019.** Researchers at UC Santa Barbara have found a way to [turn graphene into a topological insulator](#) (TI). A topological insulator is a material that is an insulator in its interior but is highly conducting on its surface.

**June 10, 2019.** A host of scientists and researchers including those from universities and institutions in the Austria, France, Germany, India, Japan, Singapore, Taiwan, United Kingdom and United States attended an [international](#)

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

**18th International Conference on Total Reflection X-ray Fluorescence Analysis and Related Methods (TXRF-2019)**

Girona, Spain  
June 25 – 28, 2019

**Microscience Microscopy Congress 2019**

Manchester, UK  
July 1 – 4, 2019

**INTERPHEX 2019**

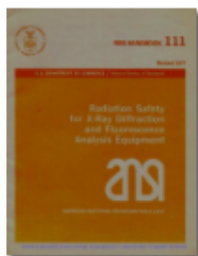
Tokyo, Japan  
July 3 – 5, 2019

**BioTaiwan**

Taipei, Taiwan  
July 3 – 5, 2019

**See the complete list >**

**Useful Link of the Month**



**Helpful Safety Resources**

[NBS Handbook 111](#) is an old but still valid resource summarizing the principles of radiation safety for X-ray diffraction (XRD) and X-ray fluorescence (XRF) laboratories.

Another useful tool is the NDT Resource Center's Introduction to Radiation Safety course materials.

**For more >**

**Planning to submit a grant?**

[seminar on advanced materials \(ICAM\)](#) being hosted by Nirmalagiri College in India from June 12 to 14.

**June 13, 2019.** Japan wants to make [reducing the glut of plastic waste in the oceans](#) a priority at the Group of 20 summit it hosted this month as governments around the world crack down on such pollution. The EU has voted to outlaw 10 single-use plastic items, including straws, forks and knives, by 2021. Such moves are setting up a showdown with the oil industry, which is pouring billions into new facilities to produce more plastic and other petrochemical products, particularly in Asia.

**June 14, 2019.** An international collaboration led by scientists at Tokyo University of Agriculture and Technology (TUAT), Japan, has developed a two-step method to more [efficiently break down carbohydrates](#) into their single sugar components, a critical process in producing green fuel. The breakdown process is called saccharification.

**June 16, 2019.** The [Albert Einstein World Award of Science](#) announced its winner, Dr. Zhong Lin Wang. The chair and regents professor of the School of Materials Science and Engineering at the Georgia Institute of Technology, Prof. Wang has become the first Chinese-American scientist to win this award.

**June 17, 2019.** A team of researchers, mainly from Tokyo University of Science, led by Prof Miyakawa, has developed a [novel technique to grow single crystals of indium-gallium-zinc oxide \(IGZO-11\)](#). The primary challenge in the synthesis of the multicomponent layered structure was the recurrent defect formation during crystal growth.

**June 17, 2019.** The pace of reductions in the cost of solar power and increases in the scale of manufacturing caught an international group of solar energy scientists by surprise, leading them to revise upwards the forecast they made two years ago. At that time, scientists focused on the challenges of achieving 3–10 terawatts (TW) of solar power capacity by 2030. In a follow-up article, they [now envision ~10 terawatts \(TW\) of solar power being deployed worldwide by 2030](#) and as much as 70 TW by 2050, which would make solar the largest energy resource globally.

**June 18, 2019.** Artificial Intelligence (AI) could help promote the development of material science and accelerate the invention of new materials, according to Chinese experts. Wang Weihua from the Institute of Physics under the Chinese Academy of Sciences said [AI is changing the way new materials are discovered](#). Through machine learning of material data, AI could outperform many material scientists and make a more efficient prediction of new materials.



**Recent Scientific Papers of Interest**

*Papers for June 2019*

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

**Fundamental parameter model for quantification of total reflection X-ray fluorescence analysis.** Szalóki, I.; Radócz, G.; Gerényi, A. *Spectrochimica Acta Part B*. Jun2019, Vol. 156, p33-41. 9p. DOI: [10.1016/j.sab.2019.04.010](#).

**New insight on carbonisation and graphitisation mechanisms as obtained from a bottom-up analytical approach of X-ray diffraction patterns.** Puech, Pascal; Dabrowska, Agnieszka; Ratel-

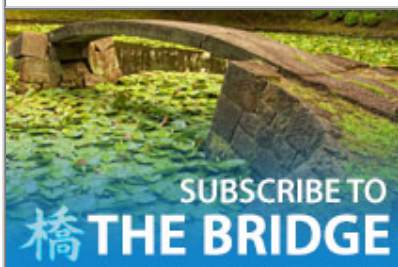




### Rigaku is happy to assist

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 >**

Ramond, Nicolas; Vignoles, Gérard L.; Monthieux, Marc. *Carbon*. Jun2019, Vol. 147, p602-611. 10p. DOI: [10.1016/j.carbon.2019.03.013](https://doi.org/10.1016/j.carbon.2019.03.013).

**In situ X-ray diffraction and the internal friction study of the binary yellow 18-carat gold alloy.** Lamiri, Imene; Abdelbaky, Mohammed S.M.; Martínez-Blanco, David; Mari, Daniele; Hamana, Djamel; García-Granda, Santiago. *Materials Science & Engineering: A*. Jun2019, Vol. 759, p514-519. 6p. DOI: [10.1016/j.msea.2019.05.086](https://doi.org/10.1016/j.msea.2019.05.086).

**Concentration-dependent structure of mixed  $\text{NH}_4\text{Cl}$  and  $(\text{NH}_4)_2\text{SO}_4$  aqueous solutions from the X-ray diffraction, Raman spectroscopy and molecular dynamics simulations.** Wang, Jihong; Lin, He; Li, Fei; Li, Shenyu; An, Shasha; Yuan, Junsheng. *Journal of Molecular Structure*. Jun2019, Vol. 1185, p469-477. 9p. DOI: [10.1016/j.molstruc.2019.01.082](https://doi.org/10.1016/j.molstruc.2019.01.082).

**A force field for MD simulations on rhenium organometallic compounds developed from enthalpy of sublimation and X-ray diffraction measurements.** Bernardes, Carlos E.S.; Donato, Mariana T.; Piedade, M. Fátima M.; Diogo, Hermínio P.; Canongia Lopes, José N.; Minas da Piedade, Manuel E. *Journal of Chemical Thermodynamics*. Jun2019, Vol. 133, p60-69. 10p. DOI: [10.1016/j.jct.2019.01.016](https://doi.org/10.1016/j.jct.2019.01.016).

**Cation distribution in nanocrystalline cobalt substituted nickel ferrites: X-ray diffraction and Raman spectroscopic investigations.** Nandan, Brajesh; Bhatnagar, M.C.; Kashyap, Subhash C. *Journal of Physics & Chemistry of Solids*. Jun2019, Vol. 129, p298-306. 9p. DOI: [10.1016/j.jpics.2019.01.017](https://doi.org/10.1016/j.jpics.2019.01.017).

**In-situ SAXS/WAXS investigations of the mechanically-induced phase transitions in semi-crystalline polyamides.** Pepin, Julie; Gaucher, Valérie; Rochas, Cyrille; Lefebvre, Jean-Marc. *Polymer*. Jun2019, Vol. 175, p87-98. 12p. DOI: [10.1016/j.polymer.2019.04.073](https://doi.org/10.1016/j.polymer.2019.04.073).

**Morphology diagram of PE gel films in wide range temperature-strain space: An *in situ* SAXS and WAXS study.** Lv, Fei; Wan, Caixia; Chen, Xiaowei; Meng, Lingpu; Chen, Xin; Wang, Daoliang; Li, Liangbin. *Journal of Polymer Science Part B: Polymer Physics*. Jun2019, Vol. 57 Issue 12, p748-757. 10p. DOI: [10.1002/polb.24829](https://doi.org/10.1002/polb.24829).

**Enrichment and distribution of counterions in spherical polyelectrolyte brushes probed by SAXS.** Ye, Zhishuang; Li, Li; Zhao, Fang; Tian, Yuchuan; Wang, Yunwei; Yang, Qingsong; Dai, Liheng; Guo, Xuhong. *Journal of Polymer Science Part B: Polymer Physics*. Jun2019, Vol. 57 Issue 12, p738-747. 10p. DOI: [10.1002/polb.24828](https://doi.org/10.1002/polb.24828).

**Non-destructive screening methodology based on ED-XRF for the classification of medieval and post-medieval archaeological ceramics.** Calparsoro, E.; Maguregui, Maite; Morillas, Hector; Arana, Gorka; Iñáñez, J.G. *Ceramics International*. Jun2019, Vol. 45 Issue 8, p10672-10683. 12p. DOI: [10.1016/j.ceramint.2019.02.138](https://doi.org/10.1016/j.ceramint.2019.02.138).

**Surface characterisation of  $\text{TiC}_x\text{N}_{1-x}$  coatings processed by cathodic arc physical vapour deposition: XPS and XRD analysis.** Siow, Ping Chuan; Ghani, Jaharah A.; Rizal, Muhammad; Jaafar, Talib Ria; Ghazali, Mariyam Jameelah; Che Haron, Che Hassan. *Surface & Interface Analysis: SIA*. Jun2019, Vol. 51 Issue 6, p611-617. 7p. DOI: [10.1002/sia.6626](https://doi.org/10.1002/sia.6626).

**Self-assembled nanoparticles based on cyclodextrin-modified pullulan: Synthesis, and structural characterization using SAXS.** Stensgaard Diget, Jakob; Lund, Reidar; Nyström, Bo; Wintgens, Véronique; Amiel, Catherine; Wimmer, Reinhard; Terndrup Nielsen, Thorbjørn. *Carbohydrate Polymers*. Jun2019, Vol. 213, p403-410. 8p. DOI: [10.1016/j.carbpol.2019.01.106](https://doi.org/10.1016/j.carbpol.2019.01.106).

**Wavelength dispersive X-ray fluorescence (WDXRF) applied to speciation of sulphur in mineral supplement for cattle: Evaluation of the chemical and matrix effects.** Babos, Diego Victor; Costa, Vinicius Câmara; Pereira-Filho, Edenir Rodrigues. *Microchemical Journal*. Jun2019, Vol. 147, p628-634. 7p. DOI: [10.1016/j.microc.2019.03.077](https://doi.org/10.1016/j.microc.2019.03.077).

***In Situ* Liquid SAXS Studies on the Early Stage of Calcium Carbonate Formation.**

Mohammed, Ahmed S. A.; Carino, Agnese; Testino, Andrea; Andalibi, Mohammad Reza; Cervellino, Antonio. *Particle & Particle Systems Characterization*. Jun2019, Vol. 36 Issue 6, pN.PAG-N.PAG. 1p. DOI: [10.1002/ppsc.201800482](https://doi.org/10.1002/ppsc.201800482).

**Comprehensive characterization of nanostructured lipid carriers using laboratory and synchrotron X-ray scattering and diffraction.**

Tetyczka, Carolin; Hodzic, Aden; Kriechbaum, Manfred; Juraic, Krunoslav; Spirk, Christina; Hartl, Sonja; Pritz, Elisabeth; Leitinger, Gerd; Roblegg, Eva. *European Journal of Pharmaceutics & Biopharmaceutics*. Jun2019, Vol. 139, p153-160. 8p. DOI: [10.1016/j.ejpb.2019.03.017](https://doi.org/10.1016/j.ejpb.2019.03.017).

**Role of water molecules in the decomposition of HKUST-1: Evidence from adsorption, thermoanalytical, X-ray and neutron scattering measurements.**

Domán, Andrea; Czakkel, Orsolya; Porcar, Lionel; Madarász, János; Geissler, Erik; László, Krisztina. *Applied Surface Science*. Jun2019, Vol. 480, p138-147. 10p. DOI: [10.1016/j.apsusc.2019.02.177](https://doi.org/10.1016/j.apsusc.2019.02.177).

**Restoring silicasol structural parameters using gradient and simulation annealing optimization schemes from small-angle X-ray scattering data.**

Kryukova, A.E.; Konarev, P.V.; Volkov, V.V.; Asadchikov, V.E. *Journal of Molecular Liquids*. Jun2019, Vol. 283, p221-224. 4p. DOI: [10.1016/j.molliq.2019.03.070](https://doi.org/10.1016/j.molliq.2019.03.070).

**Monte Carlo simulation of portable X-ray fluorescence setup: Non-invasive determination of gold leaf thickness in indo-Portuguese panel paintings.**

Pessanha, S.; Manso, M.; Antunes, V.; Carvalho, M.L.; Sampaio, J.M. *Spectrochimica Acta Part B*. Jun2019, Vol. 156, p1-6. 6p. DOI: [10.1016/j.sab.2019.04.006](https://doi.org/10.1016/j.sab.2019.04.006).

**A sustainable and simple energy dispersive X-ray fluorescence method for sulfur determination at trace levels in biodiesel samples via formation of biodiesel spots on a suitable solid support.**

Marguí, Eva; Resano, Martín; Queralt, Ignasi. *Spectrochimica Acta Part B*. Jun2019, Vol. 156, p7-12. 6p. DOI: [10.1016/j.sab.2019.04.003](https://doi.org/10.1016/j.sab.2019.04.003).

***In-situ* versus laboratory characterization of historical site in marine environment using X-ray fluorescence and Raman spectroscopy.**

Filho, F.F. Mendonça; Morillas, H.; Derluyn, H.; Maguregui, M.; Grégoire, D. *Microchemical Journal*. Jun2019, Vol. 147, p905-913. 9p. DOI: [10.1016/j.microc.2019.02.014](https://doi.org/10.1016/j.microc.2019.02.014).

**Combination of extraction induced by microemulsion-breaking and pre-concentration using magnetic nanoparticles for multi-element determination of Cd, Cr, Cu and Pb in gasoline samples using energy dispersive X-ray fluorescence spectrometry.**

Meira, Lucilia A.; Almeida, Jorge S.; de S. Dias, Fábio; Teixeira, Leonardo S.G. *Microchemical Journal*. Jun2019, Vol. 147, p660-665. 6p. DOI: [10.1016/j.microc.2019.03.068](https://doi.org/10.1016/j.microc.2019.03.068).

