Rigaku Leading With Innovation

X-ray Diffraction & Elemental Analysis

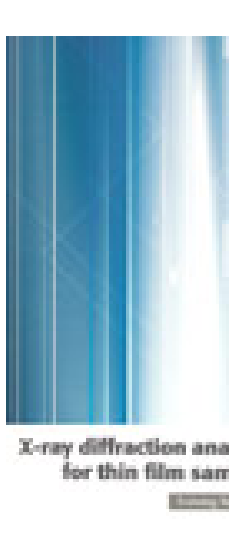
Welcome

ACHEMA 2015 took place in Frankfurt this month. More than 166,000 participants used the five-day event to see the offerings of 3,813 exhibitors from the chemical, pharma and food industries. Rigaku employed this venue to introduce the NEX DE direct excitation energy dispersive X-ray fluorescence spectrometer.

Speaking of scientific conferences, please come and see us at SEMICON in San Francisco and the American Crystallographic Association meeting in Philadelphia.

For your continuing education, the second to last installment of the X-ray diffraction Thin Film Training Textbook is published. We have two labs in the spotlight this month, one featuring a XRD user and the other XRF. Dr. Zaumseil is a researcher at IHP (Innovations for high performance microelectronics) in Frankfurt (Oder), Germany and has two SmartLabs. Included is a research paper by Dr. Zaumseil that discusses basis-forbidden diffraction. In the XRF spot, the Chikyu lab employs a Supermini to explore the deep sea and elucidate mechanisms of mega-quakes. Enjoy the newsletter.

R.C. Tisdale, Ph.D. – Editor



Thin Film Training Textbook

High-resolution X-ray Diffraction Method (Part 18)

Rigaku Corporation

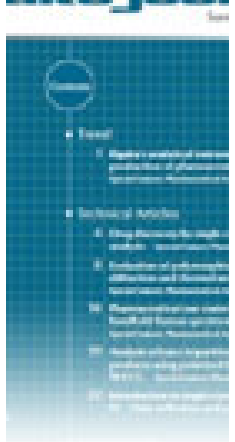
At the beginning of Section 7.1.2, we stated that the electron density in a material is not uniform. The concentration and regularity in the electron density depends on the type of element constituting the material, the crystallinity, and the symmetry of the crystal. Next, we discuss scattering based on the type of element and the crystal system. **Read more >**

Featured XRD Rigaku Journal Article

Crystal defects in SiC wafers and a new X-ray topography system

Application Laboratory, Rigaku Corporation

High-voltage and high-efficiency power devices are in strong demand as a way of decreasing energy consumption in a wide range of industrial and consumer products. Wide band gap semiconductors such as SiC, GaN, and diamond are candidates for producing these next generation power devices. **For more >**



Featured XRF Rigaku Journal Article

Elemental analysis of PM2.5 with energy dispersive X-ray fluorescence spectrometer NEX CG

Application Laboratory, Rigaku Corporation

Concerns about the effect of atmospheric aerosol particles have been increasing in recent years and its impact on global climate, air pollution and human health have been studied extensively. Recent reports of extremely high concentration levels of PM2.5 in China have drawn worldwide attention to this issue as well. **For more >**

XRD Application Note

Measurement of ultra-small samples using D/MAX-RAPID II

Rigaku Corporation

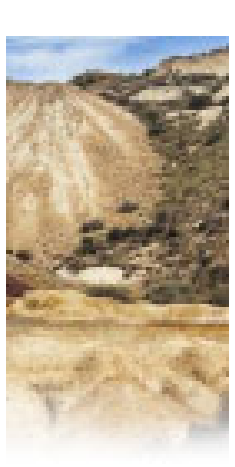
In investigations that rely on information gained from evidence left at the scene of a traffic accident, evidence is often limited in the amount available for testing or consists of microscopic traces, which made it difficult to acquire sufficient results with conventional XRD systems. The D/MAX-RAPID II, equipped with a confocal mirror, combines high-brilliance incident X-rays with a large active-area 2D detector, allowing for rapid micro area measurements of several 10 μm in about 10 minutes. **For more >**

WDXRF Application Note

Standardless Thickness and Composition Analysis of ITO Thin Film with Supermini200

Rigaku Corporation

Touchscreen panels have nowadays become common displays used for many electronic products such as ATMs, ticketing machines, home appliances, laptops, tablets, gaming consoles, music players and smart phones. Their unique function is realized by thin layers built into the display known as transparent electroconductive film, which is electrically conductive and optically transparent. Indium tin oxide (ITO) is one of the most widely used transparent electroconductive materials. Its elemental composition and film thickness are important parameters determining the characteristics of touchscreen panels and therefore the quick, simple and accurate analysis of ITO film is important. **For more >**

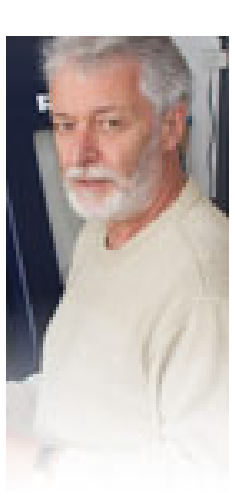


EDXRF Application Note

Analysis of Pb/Zn Ore

Applied Rigaku Technologies

Elemental analysis is important in the analysis of ores, from screening at the mine site and throughout the processing areas to final analysis. Majors and minors are important during processing, to ensure proper extraction and process control. Trace elemental analysis, especially of precious metals, is also extremely important to ensure the value of the processing is optimized. In lead/zinc ores the money elements are lead, zinc and in some ores silver, as well. Along the entire processing line, a fast and simple technique is required to monitor these and other elements. Rigaku offers the NEX CG EDXRF elemental analyzer to meet these industry challenges. **For more >**



Featured Article

Is silicon 200 diffraction a basis-forbidden diffraction or not?

From time to time we observe *200* and *222* diffraction from silicon (100) and (111) single crystal substrate, respectively. However, in general those are basis-forbidden according to crystallography and shouldn't appear. Dr. Peter Zaumseil at IHP in Germany recently investigated the phenomenon using two SmartLabs with different optics configurations and concluded that these spurious reflections are due to so-called "*multiple diffraction*". **For more >**

Customer in the Spotlight

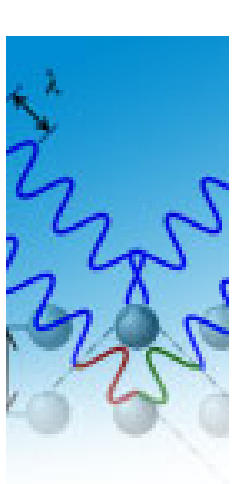
Dr. Peter Zaumseil, IHP, Frankfurt (Oder), Germany

Dr. Zaumseil is a researcher at IHP (Innovations for High Performance Microelectronics) in Frankfurt (Oder), Germany. He has published approximately 300 scientific papers, mostly related to semiconductor materials investigation using high-resolution X-ray diffraction, reflectometry and topography. **For more >**

Lab in the Spotlight

Chikyu lab to explore the deep sea and elucidate mechanisms of megaquake outbreak

Chikyu is a Japanese drilling-riser equipped science vessel, part of the International Ocean Discovery Program (IODP), which also has *JOIDES Resolution*, an American riserless drilling vessel. **For more >**



Material Analysis in the News

News for June 2015

June 1, 2015. A team led by DESY scientists has designed, fabricated and successfully tested a novel X-ray lens that produces sharper and brighter images of the nano world. The lens employs an innovative concept to redirect X-rays over a wide range of angles, making a high convergence power. The researchers manufactured a wedged lens from 5500 alternating layers of silicon carbide (SiC) and tungsten (W), varying in thickness. The final lens cut from these deposits was 40 micrometres (millionths of a metre) wide, 17.5 micrometres thick and 6.5 micrometres deep.

June 3, 2015. Physicists have painted an in-depth portrait of charge ordering — an electron self-organization regime in high-temperature superconductors that may be intrinsically intertwined with superconductivity itself. University of British Columbia researchers confirm that charge ordering forms a predominantly one dimensional 'd-wave pattern'.

June 8, 2015. Sixty-eight projects have been selected to share over $60 million of US Department of Energy (DOE) nuclear energy research and infrastructure enhancement awards. The projects, including some international collaborations, have been selected for their potential to create scientific breakthroughs.

June 8, 2015. U.S. President Obama has named Dr. Claudio Pellegrini and Dr. Charles V. (Chuck) Shank as recipients of the Enrico Fermi Award, one of the government's oldest and most prestigious awards for scientific achievement. The Presidential award carries an honorarium of $50,000, shared equally, and a medal. The award is administered on behalf of the White House by the U.S. Department of Energy.

June 9, 2015. Researchers working at the PETRA III synchrotron in Hamburg have witnessed changes in single silver bromide crystal grains in Kodak linagraph paper happening within five-millisecond timescales. That led to a discovery, which Jianwei Miao from University of California, Los Angeles calls 'completely accidental', of grain rotations and lattice deformations never seen during chemical reactions before. This underlines the power of their nanodiffraction technique, Miao says. 'As advanced synchrotron light sources are currently under rapid development we anticipate that in-situ x-ray nanodiffraction can be broadly applied to materials science, nanoscience, physics, and chemistry,' he stresses.

June 12, 2015. Scientists at Argonne have created a new way of manipulating high-intensity X-rays, which will allow researchers to select extremely brief but precise X-ray bursts for their experiments. Their micro-electromechanical device consists of a small oscillating mirror to manipulate the reflection of an incoming X-ray at a particular critical angle.

June 16, 2015. A team based at the Laboratory for Attosecond Physics (LAP) at LMU Munich and the Max Planck Institute of Quantum Optics (MPQ) has validated a novel laser-driven means of generating bright and highly energetic X-ray beams. With the aid of two laser pulses, the researchers have generated ultrashort bursts of X-rays with defined wavelengths tailored for different applications.

June 18, 2015. In a new study, researchers explain why one particular cathode material works well at high voltages, while most other cathodes do not. Researchers used a powerful X-ray imaging technique, called Bragg coherent diffractive imaging, combined with new data analysis algorithms to gain insights - at the nanoscale level - on the mechanical properties of a cathode material called an LNMO spinel (composed of lithium, nickel, manganese and oxygen atoms).

Recent Scientific Papers of Interest

Papers for June 2015

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

***In situ* analysis of electrocrystallization process of metal electrodeposition with confocal energy dispersive X-ray diffraction based on polycapillary X-ray optics.** Li, Fangzuo; Liu, Zhiguo; Sun, Tianxi; Yang, Chaolin; Sun, Weiyuan; Sun, Xuepeng; Ma, Yongzhong; Ding, Xunliang. *Nuclear Instruments & Methods in Physics Research Section A*. Jun2015, Vol. 785, p201-205. 5p. DOI: 10.1016/j.nima.2015.03.015.

Use of Monte Carlo simulations for cultural heritage X-ray fluorescence analysis. Brunetti, Antonio; Golosio, Bruno; Schoonjans, Tom; Oliva, Piernicola. *Spectrochimica Acta Part B*. Jun2015, Vol. 108, p15-20. 6p. DOI: 10.1016/j.sab.2015.03.014.

A Review of Application of Total Reflection X-ray Fluorescence Spectrometry to Water Analysis. Pashkova, G. V.; Revenko, A. G. *Applied Spectroscopy Reviews*. Jun2015, Vol. 50 Issue 6, p443-472. 30p. DOI: 10.1080/05704928.2015.1010205.

High-temperature dehydration of talc: a kinetics study using *in situ* X-ray powder diffraction. Wang, Duojun; Yi, Li; Huang, Bojin; Liu, Chuanjiang. *Phase Transitions*. Jun2015, Vol. 88 Issue 6, p560-566. 7p. DOI: 10.1080/01411594.2014.1002092.

Surface Layer Analysis of Si Sphere by XRF and XPS. Zhang, Lulu; Azuma, Yasushi; Kurokawa, Akira; Kuramoto, Naoki; Fujii, Kenichi. *IEEE Transactions on Instrumentation & Measurement*. Jun2015, Vol. 64 Issue 6, p1509-1513. 5p. DOI: 10.1109/TIM.2015.2389352.

Nondestructive analysis of Portuguese 'dinheiros' using XRF: overcoming patina constraints. Pessanha, Sofia; Costa, Mário; Oliveira, Maria; Jorge, Maria; Carvalho, Maria. *Applied Physics A: Materials Science & Processing*. Jun2015, Vol. 119 Issue 3, p1173-1178. 6p. DOI: 10.1007/s00339-015-9087-2.

Metal contamination of home garden soils and cultivated vegetables in the province of Brescia, Italy: Implications for human exposure. Ferri, Roberta; Hashim, Dana; Smith, Donald R.; Guazzetti, Stefano; Donna, Filippo; Ferretti, Enrica; Curatolo, Michele; Moneta, Caterina; Beone, Gian Maria; Lucchini, Roberto G. *Science of the Total Environment*. Jun2015, Vol. 518/519, p507-517. 11p. DOI: 10.1016/j.scitotenv.2015.02.072.

Usable Values of Nickel Ore and Nickel Concentrate Certified Reference Materials. Cheng, Zhizhong; Liu, Mei; Huang, Hongku; Gu, Tiexin; Yan, Weidong; Wen, Hongli. *Geostandards & Geoanalytical Research*. Jun2015, Vol. 39 Issue 2, p221-232. 12p. DOI: 10.1111/j.1751-908X.2014.00261.x.

The Monte Carlo code MCSHAPE: Main features and recent developments. Scot, Viviana; Fernandez, Jorge E. *Spectrochimica Acta Part B*. Jun2015, Vol. 108, p53-60. 8p. DOI: 10.1016/j.sab.2015.02.005.

High temperature X-ray diffraction and thermo-gravimetrical analysis of the cubic perovskite $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ under different atmospheres. Sahini, M. G.; Tolchard, J. R.; Wiik, K.; Grande, T. *Dalton Transactions: An International Journal of Inorganic Chemistry*. 6/21/2015, Vol. 44 Issue 23, p10875-10881. 7p. DOI: 10.1039/c4dt03963g.

***In situ* X-ray diffraction study of decomposition of polycyclic aromatic hydrocarbons at pressures of 7–15 GPa: Implication to fluids under the Earth's and planetary environments.** Chanyshev, Artem D.; Litasov, Konstantin D.; Shatskiy, Anton F.; Ohtani, Eiji. Chemical Geology. Jun2015, Vol. 405, p39-47. 9p. DOI: 10.1016/j.chemgeo.2015.04.004.

The evolution with strain of the stored energy in different texture components of cold-rolled IF steel revealed by high resolution X-ray diffraction. Wauthier-Monnin, A.; Chauveau, T.; Castelnau, O.; Réglé, H.; Bacroix, B. *Materials Characterization*. Jun2015, Vol. 104, p31-41. 11p. DOI: 10.1016/j.matchar.2015.04.005.

The determination of crystal structures of active pharmaceutical ingredients from X-ray powder diffraction data: a brief, practical introduction, with fexofenadine hydrochloride as example. Brüning, Jürgen; Schmidt, Martin U. *Journal of Pharmacy & Pharmacology*. Jun2015, Vol. 67 Issue 6, p773-781. 9p. DOI: 10.1111/jphp.12374.

***In situ* time resolved wide angle X-ray diffraction study of nanotube carpet growth: Nature of catalyst particles and progressive nanotube alignment.** Landois, Périne; Pinault, Mathieu; Rouzière, Stéphan; Porterat, Dominique; Mocuta, Cristian; Elkaim, Erik; Mayne-L'Hermite, Martine; Launois, Pascale. *Carbon*. Jun2015, Vol. 87, p246-256. 11p. DOI: 10.1016/j.carbon.2015.01.046.

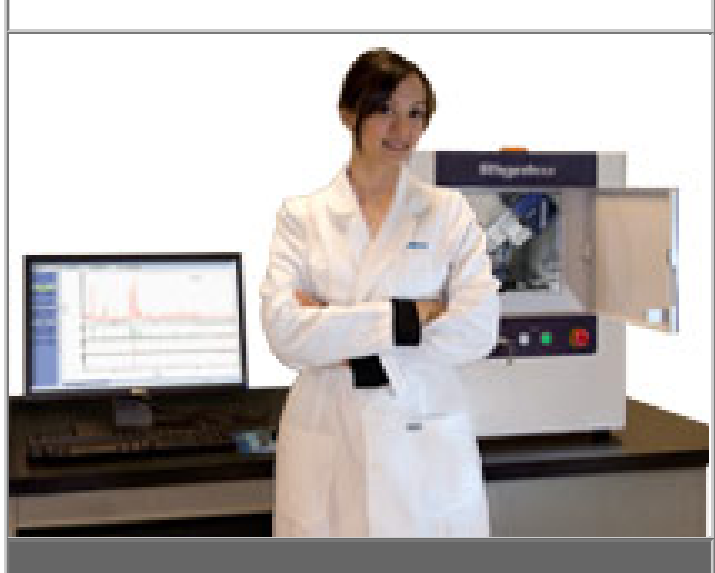
***Ab initio* simulation of diffractometer instrumental function for high-resolution X-ray diffraction.** Mikhalychev, Alexander; Benediktovitch, Andrei; Ulyanenkova, Tatjana; Ulyanenkov, Alex. *Journal of Applied Crystallography*. Jun2015, Vol. 48 Issue 3, p679-689. 11p. DOI: 10.1107/S1600576715006986.

Changes in asphaltene structure during thermal cracking of residual oils: XRD study. AlHumaidan, Faisal S.; Hauser, Andre; Rana, Mohan S.; Lababidi, Haitham M.S.; Behbehani, Montaha. *Fuel*. Jun2015, Vol. 150, p558-564. 7p. DOI: 10.1016/j.fuel.2015.02.076.

Maximum *a posteriori* estimation of crystallographic phases in X-ray diffraction tomography. Gürsoy, Doĝa; Biçer, Tekin; Almer, Jonathan D.; Kettimuthu, Raj; Stock, Stuart R.; De Carlo, Francesco. *Philosophical Transactions of the Royal Society A: Mathematical, Physical & Engineering Sciences*. 6/13/2015, Vol. 373 Issue 2043, p1-1. 1p. DOI: 10.1098/rsta.2014.0392.

XRD and TEM study of bainitic ferrite plate thickness in nanostructured, carbide free bainitic steels. Yoozbashi, M.N.; Yazdani, S. *Materials Chemistry & Physics*. Jun2015, Vol. 160, p148-154. 7p. DOI: 10.1016/j.matchemphys.2015.03.071.

MiniFlex – qualitative and quantitative analysis of polycrystalline materials



Benchtop X-ray diffraction (XRD) instrument

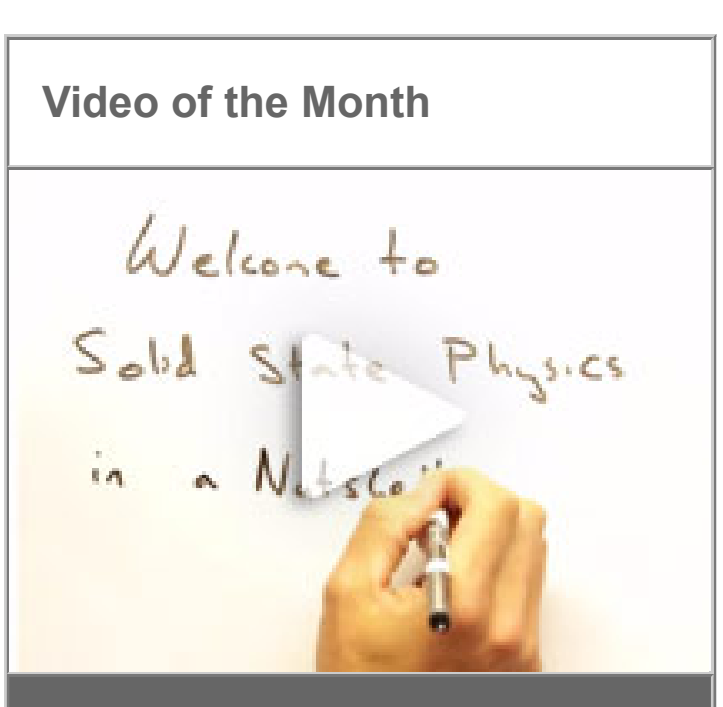
Ideally-suited for today's fast-paced XRD analyses, the 5th generation MiniFlex delivers speed and sensitivity through innovative technology enhancements such as the optional D/teX high speed detector coupled with the new 600 W X-ray source. The optional graphite monochromator, coupled with the standard scintillation counter, maximizes sensitivity by optimizing peak-to-background ratios. If resolution is paramount, incident and diffracted beam slits can be selected to provide the desired resolution. For high sample throughput, MiniFlex is the only benchtop XRD system with an available sample changer. Whether used for teaching X-ray diffraction at the college and university level, or routine industrial quality assurance, the MiniFlex delivers both performance and value. **For more >**

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 new 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 >**

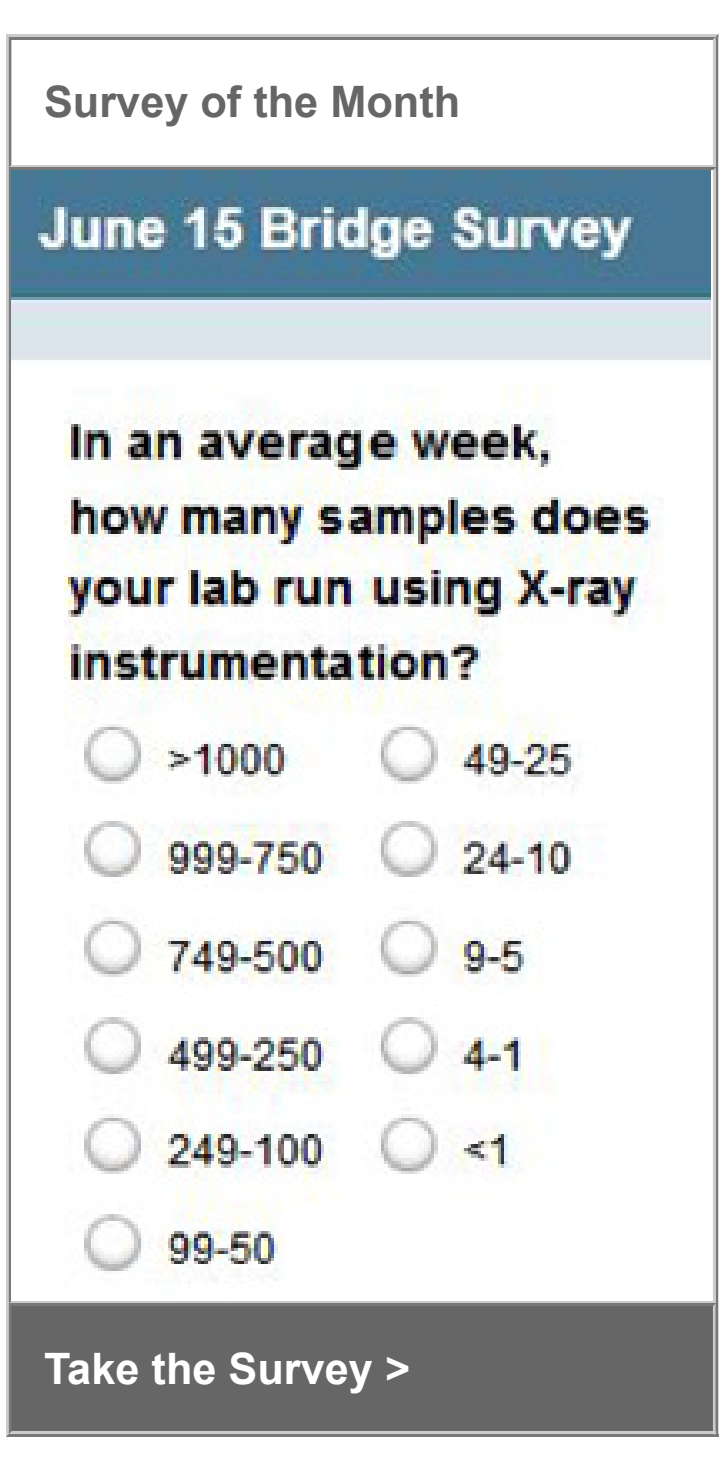
Video of the Month



Solid State Physics in a Nutshell: Powder Diffraction

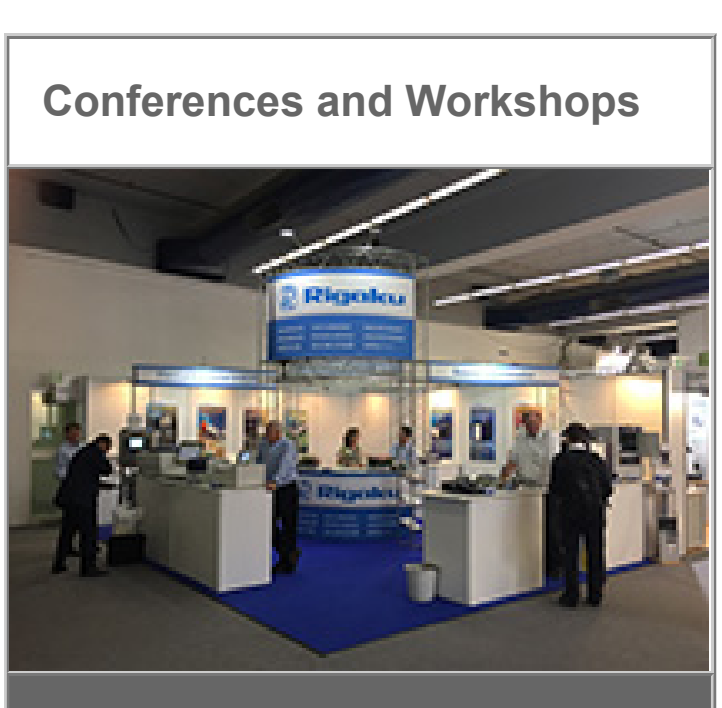
First semester solid state physics short videos produced by the Colorado School of Mines. Referenced to Kittel's 8th edition. **Watch the video >**

Survey of the Month



Take the Survey >

Conferences and Workshops



Join Rigaku at future meetings

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

SEMICON
San Francisco, CA, USA
July 14 – 16, 2015

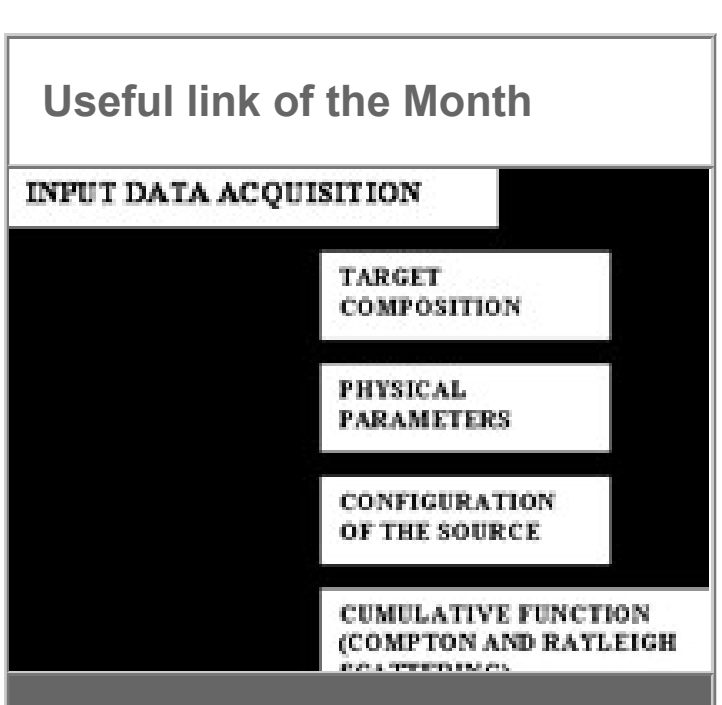
Denver X-ray Conference (DXC)
Westminster, CO, USA
August 3 – 7, 2015

American Chemical Society Fall (ACS)
Boston, MA, USA
August 16 – 18, 2015

Canadian Mineral Analysts (CMA)
Ottawa, ON, Canada
September 14 – 15, 2015

See the complete list >

Useful link of the Month



MCSHAPE

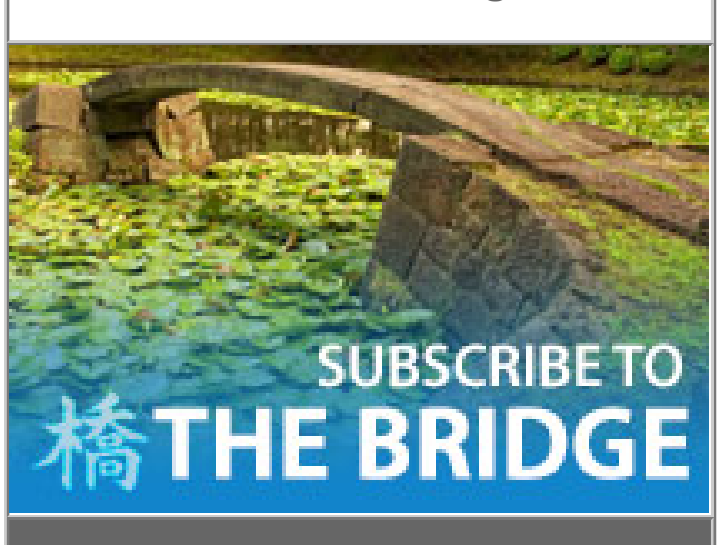
MCSHAPE is a general purpose Monte Carlo code developed at the University of Bologna to simulate the diffusion of X- and gamma-ray photons with the special feature of describing the full evolution of the photon polarization state along the interactions with the target. The prevailing photon-matter interactions in the energy range 1 – 1000 keV, Compton and Rayleigh scattering and photoelectric effect, are considered. **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 life sciences. **Register >**

Last Month's Survey