Rigaku
Applied Rigaku Technologies, Inc.

X-ray Diffraction & Elemental Analysis

橋 THE BRIDGE
MATERIALS ANALYSIS eNEWSLETTER
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MiniFlex – a teaching tool for every materials science department

Cost-effective way to bring XRD experiments into the teaching laboratory

Materials Science has become an essential part of both industrial and academic research. At today's universities the education of future material scientists is essential to help further ongoing technological advancement. As part of this course of study, hands-on experience with IR, Raman, TEM, SEM and XRD measurement techniques is important in teaching students the skills required for the analysis of advanced materials. The MiniFlex benchtop XRD system is an easy-to-use, cost-effective way to bring XRD experiments into the teaching laboratory. **For more >**

The ZSX® Primus III+

The most affordable tube-above WDXRF spectrometer on the market today

Rigaku ZSX Primus III+ delivers rapid quantitative determination of major and minor atomic elements, from oxygen (O) through uranium (U), in a wide variety of sample types — with minimal standards. The ZSX Primus III+ features an innovative optics-above configuration. Never again worry about a contaminated beam path or down time due to sample chamber maintenance. The optics-above geometry eliminates cleaning worries and increases up time. **For more >**

Rigaku nano3DX is a true X-ray microscope

High-contrast, high-resolution computed micro-tomography

Rigaku has developed the nano3DX, 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 >**

Conferences and Workshops

Join Rigaku at future meetings

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

60th ISA Analysis Division Symposium
Galveston, TX, USA
April 26 – 30, 2015

International Hazardous Materials
Baltimore, MD, USA
May 28 – 31, 2015

AAPG
Denver, CO, USA
May 31 – June 3, 2015

XRF Spectrometry Short Course with Special Topical Workshops
London, Ontario, Canada
June 1 – 12, 2015

See the complete list >

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 >**

Welcome

In the April issue of *The Bridge*, Rigaku brings you a selection of interesting news and scientific papers for the past month. Drawing upon Geoffrey Chaucer's *The Canterbury Tales* (1392) for inspiration, as it contained the first recorded association between 1 April and foolishness, scientists have confirmed the urban legend that depleted AA batteries will bounce higher (*vide infra*).

For your continuing education, the latest installment of the X-ray diffraction *Thin Film Training Textbook* covers rocking curve analysis. We also present a recent article from the *Rigaku Journal* that discusses sample preparation - for pressed and loose powders - as related to elemental analysis by X-ray fluorescence spectrometry. Finally, the fascinating conservation research of Prof. Fumiyoshi Kirino at Tokyo University of the Arts is highlighted. Enjoy the newsletter!

R.C. Tisdale, Ph.D. – Editor

Thin Film Training Textbook

High-resolution X-ray Diffraction Method (Part 16)
Rigaku Corporation

In general, the thickness and composition of the multilayer film cannot be determined directly from the measured rocking curve. In actual analysis, we must simulate the rocking curve of a multilayer film model (of hypothetical film thickness and composition) as described in the previous section and change the thickness and the composition to reproduce the measured rocking curve in the analysis. This section presents several examples to help clarify the relationship between the rocking curve and the layer structure. **For more >**

Featured Rigaku Journal Article

Sample preparation for X-ray fluorescence analysis
Application Laboratory, Rigaku Corporation

There are two main sample preparation techniques for measurement of powders with XRF—pressed and loose powder methods—neither requiring any chemical processes. In either case the proper sample preparation and accessories need to be selected to prevent breakage of the pressed powder during measurement. When a thin film for analysis surface (hereafter "sample film") or a binder is used, it is recommended to select the proper sample preparation method to minimize analysis errors of target elements. This note describes key points and considerations for sample preparation by pressed and loose powder methods. In addition, sample preparation technique for the analysis of small quantities of powder sample is introduced. **For more >**

WDXRF Application Note

Elemental Determination of Whole Coal by the Pressed Powder Method
Rigaku Corporation

Coal is the most abundant source of energy amongst the remaining fossil fuels in the world. Coal production is classified into two groups based on its usage. Thermal (steam) coal is used for generation of electricity, whereas metallurgical (coking) coal is mainly used for production of steel. Coal beneficiation (coal cleaning) is critical since it determines the quality of the final product. Rapid and accurate elemental determination is therefore important in order to assure that components harmful to the environment, such as ash and sulfur, are sufficiently low. X-ray fluorescence (XRF) spectrometry using the pressed powder method is a simple analysis technique that can rapidly determine elemental concentration of coal with high accuracy and precision. **For more >**

EDXRF Application Note

Analysis of Iron Concentrates
Applied Rigaku Technologies

Ore is ground, cleaned, separated and concentrated in preparation for smelting. Impurities such as silicon dioxide and sulfur are considered penalty elements as they can adversely affect the quality of the beneficiation, concentrating and smelting processes, as well as the final properties of the iron or steel being produced. Rigaku NEX QC+ offers technicians a fast and simple means of monitoring elemental composition of ores and concentrates, and is a tool that can be used for quality checks throughout the entire smelting process. **For more >**

Customer in the Spotlight

DiMAX RAPID II with CMF and RINT – Ultima III
at Tokyo University of the Arts

Professor Fumiyoshi Kirino in the Graduate School of Conservation for Cultural Property uses his materials analysis expertise to investigate suitable methods for the conservation and restoration of cultural properties. For his research, he uses the Rigaku Ultima III X-ray diffractometer, the DiMAX RAPID II with CMF optics, X-ray fluorescence, electron microscopy, and Infrared and Ultraviolet spectrometry. He needs to know the basic elemental composition of materials, as well as their atomic structures. For the restoration and preservation of cultural assets, he studies how materials change over time. Using a variety of analytical instruments is crucial to the success of his studies. **For more >**

Scientific Book Review

What Should We Be Worried About?: Real Scenarios That Keep Scientists Up at Night
(Edge Question Series), edited by John Brockman, Harper Perennial, New York, 2014, 528 pages, ISBN: 978-0062296238.

This Idea Must Die: Scientific Theories That Are Blocking Progress
(Edge Question Series), edited by John Brockman, Harper Perennial, New York, 2015, 592 pages, ISBN: 978-0062374349.

John Brockman, founder of the Edge Foundation, a web-based think tank, edited both of these books. Each year he asks a large group of people—many of them members of the Edge Foundation—the question for the year. Each book is a collection of short essays that answer the title question from thinkers in many fields. Several are from authors that have been reviewed here in the past, including Sean Carroll, Steven Pinker, Charles Seife, Nicholas Nassim Taleb and Sherry Turkle, so some of the answers may be familiar to you. Each essay is accompanied by a short bio of the author and the title, or titles, of some recent book. **For more >**

Material Analysis in the News

News for April 2015

April 1, 2015. Inspired by a video, scientists in the US have confirmed that a simple bounce test can be used as a technique to indicate charge in a battery. A team led by Daniel Steingart of Princeton University has correlated the coefficient of restitution (COR), a measure of bounce, with batteries at various charges and determined their charge to a similar degree of accuracy as *in situ* energy-dispersive X-ray diffraction (EDXRD).

April 6, 2015. Scientists at the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) have published the world's largest set of data on the complete elastic properties of inorganic compounds, increasing by an order of magnitude the number of compounds for which such data exists. This new data set is expected to be a boon to materials scientists working on developing new materials where mechanical properties are important, such as for hard coatings, or stiff materials for cars and airplanes.

April 13, 2015. Scientists have developed a new approach that combines ptychographic X-ray imaging and fluorescence microscopy to study the important role trace elements play in biological functions on hydrated cells. Trace metals are important in normal and disease-causing biological functions. Until now, it was impossible to obtain images of biological samples with such high combined structural and chemical fidelity.

April 16, 2015. A novel X-ray fluorescence detector, called a Maia detector, reveals structural changes in lithium-ion batteries. A team of researchers at DESY's X-ray source PETRA III, led by Dr. Ulrike Bösenberg, performed fluorescence studies that revealed that the internal structure of the battery material was significantly damaged following just a few charging cycles. The instrument was jointly developed by Brookhaven National Laboratory and CSIRO in the US and contains 400 individual elements that are capable of collecting the fluorescent radiation from the sample.

April 21, 2015. The Consumers Association of India (CAI) has demanded stern action against jewelers who sell gold mixed with white metals. According to CAI, there have been instances of various white metals such as osmium, palladium, iridium and ruthenium being added to gold as they have different melting points and cannot be traced easily. CAI suggested X-ray fluorescence testing to determine the purity of gold.

April 25, 2015. Biofuel struggles with economics and the environment. Recent growth in petroleum supplies and a slide in prices has cut into biofuel research funding. One of the leading issues in the development of a biofuel stock into an acceptable renewable biofuel has been cost.

April 26, 2015. A group of scientists from the Lawrence Berkeley National Laboratory recently presented an intuitive view of the nature of fluctuation X-ray scattering data and their properties. The scientists have shown that fluctuation scattering is a natural extension of traditional small-angle X-ray scattering and that a number of fundamental operational properties translate from small- and wide-angle X-ray scattering into fluctuation scattering.

Recent Scientific Papers of Interest

Papers for April 2015

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

Ferroelectricity in high-density H_2O ice. Caracas, Razvan; Hemley, Russell J. *Journal of Chemical Physics*. 2015, Vol. 142 Issue 13, p1-6. 6p. 2 Diagrams, 4 Graphs. DOI: 10.1063/1.4916564.

The Phase Equilibria of the 75 at.% Al-Zn-Ce-Fe Quaternary System at 600 °C. Ji, Li; Li, Zhi; Wu, Yu; Liu, Yongxiong; Zhao, Manxiu; Yin, Fucheng. *Journal of Phase Equilibria & Diffusion*. Apr2015, Vol. 36 Issue 2, p92-98. 7p. 2 Charts, 5 Graphs. DOI: 10.1007/s11669-015-0363-9.

Controllable synthesis of hierarchical SnO_2 microspheres for dye-sensitized solar cells. Wang, Yu-Fei; Li, Xi-Fei; Li, De-Jun; Sun, Yuan-Wei; Zhang, Xian-Xi. *Journal of Power Sources*. Apr2015, Vol. 280, p476-482. 7p. DOI: 10.1016/j.powsour.2015.01.115.

Al-doped SnO_2 hollow sphere as a novel anode material for lithium ion battery. Wei, Chengwen; Zhang, Guoxi; Bai, Ying; Yan, Dong; Yu, Caiyan; Wan, Ning; Zhang, Weifeng. *Solid State Ionics*. Apr2015, Vol. 272, p133-137. 5p. DOI: 10.1016/j.ssi.2015.01.014.

Correlative Studies on Sintering of $NiBaTiO_3$ Multilayers Using X-ray Computed Nanotomography and FIB-SEM Nanotomography. Yan, Zilin; Guilion, Olivier; Martin, Christophe L.; Wang, Steve; Lee, Chul-Seung; Chartier, Frederic; Bouvard, Didier. *Journal of the American Ceramic Society*. Apr2015, Vol. 98 Issue 4, p1338-1346. 9p. DOI: 10.1111/jace.13416.

An X-ray investigation of the adsorption of methane, water, and their mixtures in carbon micropores. Futamura, Ryusuke; Ozeki, Sumio; Iiyama, Taku. *Carbon*. Apr2015, Vol. 85, p8-15. 8p. DOI: 10.1016/j.carbon.2014.12.043.

Comprehension of direct extraction of hydrophilic antioxidants using vegetable oils by polar paradox theory and small angle X-ray scattering analysis. Li, Ying; Fabiano-Tixier, Anne Sylvie; Ruiz, Karine; Rosignol Castera, Anne; Baudun, Pierre; Diat, Olivier; Chemat, Farid. *Food Chemistry*. Apr2015, Vol. 173, p873-880. 8p. DOI: 10.1016/j.foodchem.2014.10.061.

Determination of plutonium in nitric acid solutions using energy dispersive L X-ray fluorescence with a low power X-ray generator. Py, J.; Groetz, J.-E.; Hubinois, J.-C.; Cardona, D. *Nuclear Instruments & Methods in Physics Research Section A*. Apr2015, Vol. 780, p131-137. 7p. DOI: 10.1016/j.nima.2015.01.073.

Matrix effects in white-beam X-ray fluorescence holography. Dul, D. T.; Korecki, P. *Journal of Applied Crystallography*. Apr2015, Vol. 48 Issue 2, p542-549. 8p. DOI: 10.1107/S1600576715003490.

Preliminary Results: Energy Dispersive X-Ray Fluorescence and Partial Least Squares Regression for Organic Matter Determination in Soil. Melquiades, Fábio Luiz; dos Santos, Felipe Rodrigues. *Spectroscopy Letters*. 2015, Vol. 48 Issue 4, p286-289. 4p. DOI: 10.1080/00387010.2013.874532.

Rapid assessment of soil and contaminant variability via portable x-ray fluorescence spectroscopy: Copa Mina, Colombia. Paulette, Laura; Man, Titus; Weindorf, David C.; Person, Taylor. *Geoderma*. Apr2015, Vol. 243-244, p130-140. 11p. DOI: 10.1016/j.geoderma.2014.12.025.

Prospects on Low-Z Elements K Fluorescence and Actinide-Radionuclides L Fluorescence X-Ray Detection With Cooled CZT. Maia, J. M.; Curado da Silva, R. M.; Kim, Yoon-Seong. *IEEE Transactions on Nuclear Science*. Apr2015, Vol. 62 Issue 2, p577-587. 11p. DOI: 10.1109/TNS.2015.2414727.

X-ray fluorescence as a condition monitoring tool for copper and corrosive sulphur species in insulating oil. Amaro, P. S.; Faciocitti, M.; Holt, A. F.; Pilgrim, J. A.; Lewin, P. L.; Brown, R. C. D.; Wilson, G.; Jarman, P. *IEEE Transactions on Dielectrics & Electrical Insulation*. Apr2015, Vol. 22 Issue 2, p701-708. 8p. DOI: 10.1109/TDEI.2015.7076765.

Evidence for geochemical histories on Mercury: Global mapping of major elements with MESSENGER's X-Ray Spectrometer. Weider, Shoshana Z.; Nittler, Larry R.; Starr, Richard D.; Crapster-Pregont, Ellen J.; Peplowski, Patrick N.; Denevi, Brett W.; Head, James W.; Byrne, Paul K.; Hiesinger, Harald; Ebel, Denton S.; Solomon, Sean C. *Earth & Planetary Science Letters*. Apr2015, Vol. 416, p109-120. 12p. DOI: 10.1016/j.epsl.2015.01.023.

Mössbauer, magnetization and X-ray diffraction characterization methods for iron oxide nanoparticles. Gabbasov, Raul; Polikarpov, Michael; Cherepanov, Valery; Chuev, Michael; Mischenko, Iliya; Lomov, Andrey; Wang, Andrew; Panchenko, Vladislav. *Journal of Magnetism & Magnetic Materials*. Apr2015, Vol. 380, p111-116. 6p. DOI: 10.1016/j.jmmm.2014.11.032.

Crystal structure of bis(1-ammonio-1-phosphonoethyl) phosphonato[tetraoxaacadmium dihydrate: a powder X-ray diffraction study. Rukiah, Mwafik; Assaad, Thaer. *Acta Crystallographica: Section E*. 2015, Vol. 71 Issue 4, p342-345. 8p. DOI: 10.1107/S2056989015004028.

Problem of elastic anisotropy and stacking faults in stress analysis using multireflection grazing-incidence X-ray diffraction. Marciszko, Marianna; Baczmanski, Andrzej; Wróbel, Miroslaw; Seiler, Wilfrid; Braham, Chedly; Wronski, Sebastian; Wawszczak, Roman. *Journal of Applied Crystallography*. Apr2015, Vol. 48 Issue 2, p492-509. 18p. DOI: 10.1107/S1600576715002666.