

NEWS

SCIENCES

Application of X-ray fluorescence micro tomography: how and where iron is stored in plant seeds (24 November 2006)

A group of biologists led by Professor Guerinot (Dartmouth College, USA) has recently clarified that iron is stored in the developing vascular system of the seed of a plant called *Arabidopsis*. The group also found that this localization depends on a protein called VIT1, shown to transport iron to the vacuole. The experiments combined traditional mutant analysis (turning on and off the VIT1 protein) with an X-ray fluorescence micro tomography technique to obtain a map of where iron is stored in the seed. The results could help in the development of nutrient-rich seed, benefiting both human health and agricultural productivity, because iron deficiency is an area of concern in the issue of human nutrition. The experiments were done at Beamline X26A, National Synchrotron Light Source (NSLS), Brookhaven, USA. For more information, see the paper, 'Localization of Iron in *Arabidopsis* Seed Requires the Vacuolar Membrane Transporter VIT1', S. A. Kim *et al.*, *Science*, 2006; 314: 77–80.

X-rays reveal how Neanderthal teeth grew (22 November 2006)

Neanderthals were a species of the *Homo* genus who inhabited Europe and parts of western Asia approximately 24,000–350,000 years ago. It has even been suggested that Neanderthals achieved adulthood faster than modern humans do today. At the European Synchrotron Radiation Facility (ESRF), Grenoble, France, the enamel dentine junction of both a deciduous and a permanent Neanderthal molar tooth (about 130,000 years old) was studied recently by using high-resolution tomography. It was found that the dental development of Neanderthals was very similar to modern humans. The permanent molar tooth studied had completed its root growth at about 8.7 years of age, which is typical of many modern human children today. For more information on the experimental results, see the paper, 'How Neanderthal molar teeth grew', R. Macchiarelli *et al.*, *Nature*, published online 22 November 2006. For other recent interesting data on Neanderthals, see the paper, 'Palaeoanthropology: Return of the last Neanderthal', E. Delson *et al.*, *Nature*, 2006; 443: 762–763.

X-ray reflectivity provides evidence of hydrophobic gap at buried water-polymer interface (20 November 2006)

A group at the Max Planck Institute led by Professor H. Dosch recently performed detailed studies on the gap between water and a water-repelling surface. Silicon wafers, functionalized by a self-assembled monolayer of octadecyl-trichlorosilane (OTS), provide strongly hydrophobic substrates. The main interest here is what happens when water comes onto the OTS layer. The experiment was not easy, because the liquid water-solid interface is deeply buried in this case. In this research, X-ray reflectivity measurements using an unusually high-energy beam (72.5 keV) were carried out. The results indicate the existence of a hydrophobic gap on a molecular scale at the solid-water interface. For more information, see the paper, 'High-resolution *in situ* X-ray study of the hydrophobic gap at the water-octadecyl-trichlorosilane interface', M. Mezger *et al.*, *Proc. Natl. Acad. Sci. USA* published online before print 20 November 2006.

Single-shot coherent diffraction imaging using VUV-FEL (12 November 2006)

At the FLASH free-electron laser facility at DESY in Hamburg, Germany, an international team of scientists recently published the first data on diffraction imaging of a non-crystalline sample. Theoretically, a single X-ray pulse, if it is extremely bright and perfectly coherent, can produce a diffraction pattern from a large macromolecule, a virus or a cell (for example, see, 'Potential for biomolecular imaging with femtosecond X-ray pulses', R. Neutze *et al.*, *Nature*, 2000; 406: 752–757). In the present experiment, the team tested a laser pulse with 25 fs, 41013 W/cm²/pulse, containing 1012 photons at 32 nm wavelength, and obtained a coherent diffraction pattern from a nanostructured non-periodic object before this exploded into a plasma at ca. 60,000 K. They employed a novel X-ray camera assured of single-photon detection sensitivity by filtering out parasitic scattering and plasma radiation. For more information, see the paper, 'Femtosecond diffractive imaging with a soft-X-ray free-electron laser', H. N. Chapman *et al.*, *Nature Physics*, published online 12 November 2006.

Combining X-ray reflectometry and microscopy (10 November 2006)

Argonne National Laboratory researchers in collaboration with Xradia, Inc. have developed a novel X-ray surface topography technique by combining X-ray reflection, which is sensitive to height or depth on a sub nanometer scale, and full-field X-ray microscopy with condenser and objective Fresnel zone plates. Recent rapid progress in X-ray microscopy now allows scientists to obtain X-ray images with ca. 10 nm spatial resolution. However, so far, almost all full-field imaging has employed transmission geometry. The present research has extended the technique to reflection geometry. It has become possible to image the distribution of molecular-scale interfacial features directly and non-invasively with full-field imaging. Interfacial phase contrast from elementary defect structures allows direct observation of 0.6-nm-high monomolecular steps at a solid surface. For more information, see the paper, 'Observation of subnanometre-high surface topography with X-ray reflection phase-contrast microscopy', P. Fenter *et al.*, *Nature Physics*, 2006; 2: 700–704.

X-ray spectroscopy solves mystery of red Pompeii paintings (1 November 2006)

Artists in ancient Pompeii painted the town red 2,000 years ago with a brilliant crimson pigment made of cinnabar (HgS) that dominated many of the doomed city's wall paintings. The eruption of the volcano Vesuvius showered the neighbouring towns in pumice and ash, and the Villa Sora, in Torre del Greco, remained buried until just 20 years ago, which is when excavation work started. In the remains of the house, the distinctive red colour of the wall frescoes has turned black in many places. The origins of this darkening degradation have not been clearly identified yet and remain a major issue for curators. At ESRF, by aid of micro X-ray fluorescence and absorption spectroscopy, scientists analyzed red cinnabar paintings coated on a sparry calcite (CaCO₃) mortar exhibiting different levels of degradation. The results indicate two possible degradation mechanisms; formation of HgCl₂ and CaSO₄ through reaction with NaCl and SO₂ from the environment, respectively. For more information, see the paper, 'Blackening of Pompeian Cinnabar Paintings: X-ray Microspectroscopy Analysis', M. Cotte *et al.*, *Anal. Chem.*, 2006; 78: 7484–7492.

PROFESSIONAL**The 1st Ei-ichi Asada Award (20 October 2006)**

In Japan, a new award has been established in memory of the late Professor Ei-ichi Asada (1924–2005) in order to encourage promising young scientists in X-ray analysis fields. The joint recipients of the 1st award are: Dr. Kazuhiko Nakano (Osaka Electro Communication University, 'Development of confocal 3D micro XRF spectrometer-using polycapillary X-ray lenses') and Dr. Yohko Yano (Ritsumeikan University, 'Application of X-ray multilayer optics for a surface-horizontal X-ray reflectometer'). The ceremony was held during the 42nd Annual Conference on X-Ray Chemical Analysis, Japan at Meiji University, Kawasaki city.

National center for X-ray tomography opens at Berkeley (13 October 2006)

The National Center for X-ray Tomography (NCXT) has officially been dedicated at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab). The main objects are biological/biomedical imaging and cell biology. Currently, soft X-ray tomography is being developed as a new tool for visualizing the internal architecture of whole, hydrated cells. This emerging technique has several distinct advantages over existing imaging methods, and is contributing new insights into our understanding of cells, and their behavior. A new soft X-ray microscope will be constructed at the Advanced Light Source, and will be open for use by the biomedical community in spring 2007. For more information, visit the website at <http://ncxt.lbl.gov/>

Denver X-Ray Conference Awards (9 August 2006)

The following awards were presented during the plenary session of the 55th Annual Denver X-Ray Conference:

The 2006 Birks Award: Peter Wobruschek, Atominstytut, Vienna University of Technology, Vienna, Austria.

The 2006 Jerome B. Cohen Student Award (two recipients): Hanfei Yan, Columbia University, New York, NY, USA and Argonne National Laboratory, Argonne, IL, USA won the award for his work 'Dynamical Artifacts in X-ray Diffraction from Single Crystals'; Wanchuck Woo, The University of Tennessee, Knoxville, TN, USA and Oak Ridge National Laboratory, Oak Ridge, TN, USA won the award for his work 'In-Situ Time-Resolved Neutron Diffraction Measurement of Transient Material States during a Thermo-Mechanical Process Based on Quasi-Steady State Principle'.

The 2006 Hanawalt Award: Peter Wallace, Dos Arroyos Enterprises, Oro Valley, AZ, USA.

NEW PRODUCTS**SPECTRO's information package for environmental analysis with XRF and ICP (17 November 2006)**

SPECTRO Analytical Instruments is offering a free, online information package regarding current requirements and new developments for environmental analysis at <http://www.spectro.com>. The online content includes technical data sheets and application reports as to which analytical instruments and methods are best suited for the testing of drinking water, waste water, emissions or soil. For further information, contact Tom Milner, Phone: +49-2821-8922102, Fax: +49-2821-8 922200, info@spectro.com

Spellman's new high voltage power supply designed for precision e-beam applications (5 October 2006)

Spellman High Voltage Electronics Corporation (Hauppauge, NY, USA) has announced the introduction of the VS100 high voltage power supply, specifically designed for precision electron beam applications like semiconductor nano-lithography etc. Ultra low ripple (less than 75mVp-p, for 100 kV @ 100uA) and high stability make it possible to use the VS100 as an electron beam accelerator source. For further information, call +1-631 630-3000, or visit <http://www.spellmanhv.com>

Bruker AXS introduces RoHS-QUANT (3 October 2006)

Bruker AXS has introduced RoHS-QUANT, a new X-ray fluorescence (XRF) solution designed specifically for quantitative screening of chromium (Cr), lead (Pb), bromine (Br), mercury (Hg) and cadmium (Cd) elements in polymers and plastics of electrical and electronic equipment, in accordance with the new European Union 'Restriction of Hazardous Substances' (RoHS) regulations. For further information, contact Michael Willett, Investor Relations Officer, Phone: +1-978-663-3660, ext. 1411, ir@bruker-biosciences.com, <http://www.bruker-axs.de/>

Princeton's new CCD camera (17 July 2006)

Princeton Instruments/Acton (PI/Acton) has announced the addition of the PIXIS: 2048 series of front and back illuminated cameras to its acclaimed PIXIS line of CCD cameras. The cameras are based on e2v technologies CCD 42-40 - 2048x2048 format sensors with a large 26.7 mm x 26.7 mm imaging area. For the first time ever, PIXIS: 2048 offers deep cooling better than -70°C cooling (via thermo-electric peltier) with vacuum guaranteed for the entire life of the camera. The new cameras inherit previous PIXIS features including dual 100 kHz/2 MHz digitizers, ultra low read noise of 3e- rms read noise (@100 kHz), all-metal hermetic seals, easy-to-use USB2.0 interface, and single optical window design for the best optical throughput. For further information, contact Princeton Instruments Inc., Phone: +1-609-587-9797, Fax: +1-609-587-1970, moreinfo@piacton.com, <http://www.piacton.com/>

CORPORATE**PANalytical opens direct sales and support organization in Mexico (1 November 2006)**

From November 1 2006, PANalytical will conduct its business in Mexico directly as a PANalytical entity under the aegis of Spectris Mexico, instead of through its agent - PONA. PONA and PANalytical have worked together over the past 13 years. In the new organization, all PONA employees will join the newly established PANalytical Mexico. For further information, contact Folke Meijer, Brand and Communications Manager, Phone: +31-546-534383, folke.meijer@panalytical.com, <http://www.panalytical.com>

HORIBA completes second Chinese plant in Shanghai (29 September 2006)

HORIBA has announced the completion of its second Chinese plant in the Jiading District of Shanghai. For further information, visit <http://www.jp.horiba.com/>

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X-ray absorption spectroscopy aids improvement of fuel cell performance (12 January, 2007)

Platinum is the most efficient electrocatalyst for accelerating chemical reactions in fuel cells for electric vehicles. However, the reactions that take place during the stop-and-go driving of an electric car cause the platinum to dissolve, which reduces its efficiency as a catalyst. Recently, a Brookhaven National Lab group led by Dr R. Adzic found that adding gold clusters to the platinum electrocatalyst is effective in stabilizing and prolonging the life of the electrocatalyst. The group tested the performance under the oxidizing conditions of the O₂ reduction reaction and potential cycling between 0.6 and 1.1 V in over 30,000 cycles, and obtained successful results. X-ray absorption spectra measured at the Pt LIII edge clearly showed that the Au clusters contribute to protecting the platinum from being oxidized. The next step of the research is to duplicate the results in real fuel cells. For more information, see the paper, 'Stabilization of Platinum Oxygen-Reduction Electrocatalysts Using Gold Clusters', J. Zhang *et al.*, *Science*, 2007; 315:220

Synchrotron X-ray analysis of comet particles returned by Stardust spacecraft (15 December, 2006)

In January 2006, the Stardust spacecraft brought back a number of tiny particles from comet Wild 2, which is believed to have originated within a cloud of comets just beyond the orbit of Neptune called the Kuiper Belt. The particles have been analyzed by X-rays at six synchrotron radiation facilities around the world, ESRF (France), APS (Argonne, USA), SSRL (Stanford, USA), ALS (Berkeley, USA), NSLS (Brookhaven, USA) and Spring-8 (Japan). The particles from this comet are important because they are believed to be close to the starting material of the solar system, which is now about 4.5 billion years old. The particles were found to contain a wide variety of minerals and organic materials that look similar to those seen in primitive meteorites found on earth, but the samples also revealed the presence of new materials not previously found in meteorites. It was also discovered that the samples contained minerals similar to Calcium Aluminum-rich inclusions (CAI's), which can be formed at high temperatures, i.e., in the innermost part of the solar nebula, well inside the orbit of Mercury. For more information on the Stardust mission, visit <http://stardust.jpl.nasa.gov/home/index.html>. Some interesting results have been published as part of a special series of papers in the 15 December, 2006, edition of the journal *Science*.

3D imaging of GaN nano dots (~17 nm) by coherent X-ray diffraction (24 November, 2006)

By combining coherent X-ray scattering with a method of direct phase recovery called over-sampling, lens-free microscopy in the X-ray region becomes a realistic technique. The latest hot topic is the extension of the technique from two to three dimensions. One of the most promising ways of applying this technique is the recently reported combination of (i) *ab initio* phase retrieval of 2D coherent diffraction patterns with a guided hybrid input-output algorithm and (ii) 3D image reconstruction with equally sloped tomography. The scheme was applied to quantitative

3D imaging of a heat-treated GaN particle with each voxel corresponding to 17 × 17 × 17 nm³. The internal GaN-Ga₂O₃ core shell structure was successfully captured in three dimensions. For more information about the analysis, see the paper, 'Three-Dimensional GaN-Ga₂O₃ Core Shell Structure Revealed by X-Ray Diffraction Microscopy', J. Miao *et al.*, *Phys. Rev. Lett.* 2006; 97:215503

Crystal structure of the most famous artificial sweetener determined after more than a century (23 November, 2006)

Sodium saccharinate, NaC₇H₄NO₃S · xH₂O, listed in most catalogues as a dihydrate (x = 2), has been extensively used as a food additive and has constituted the basic component of the diabetics' diet for about 125 years. However, due to such factors as the instability of the crystal, the large unit cell and a very complex and heavily disordered structure, scientists have been unable to establish its composition with any certainty; until now. Dr. P. Naumov (National Institute for Materials Science, Japan) and his collaborators recently succeeded in the first determination of the crystal structure, by using special techniques for preserving unstable crystals during X-ray data collection. This crystal structure, which has as many as 16 formula units in the asymmetric unit (Z' = 16) as well as one of the largest unit cells, represents one of the most difficult cases for a small molecular species such as the saccharinate ion. It was found that, instead of being a dehydrate, the crystal is in fact a 1.875 hydrate, because of a structural misfit and the lack of two water molecules per asymmetric unit. The composition can be best described as Na₆₄(C₇H₄NO₃S)₆₄ · 120H₂O. At a meeting of the Asian Crystallographic Association held in Tsukuba, Japan, Dr. Naumov received the Best Presentation Award. For more information, see the paper, 'Solid-state structure and temperature/evacuation-induced dehydration of sodium saccharinate 1.875 hydrate', P. Naumov *et al.*, *Angewandte Chemie, International Edition in English*, 2005; 44: 1251

Combination of several in-situ X-ray methods clarify how micropores are created in zeolites (2 November, 2006)

Professor Weckhuysen (Utrecht University, Netherlands) and his colleagues have recently solved the molecular mechanism for the organic-base-mediated synthesis of zeolites. AlPO₄-5 is a typical zeolite, which can be constructed from aluminium-based tetrahedra (AlO₄) and phosphorus-based tetrahedra (PO₄). The research group compared the formation of the chargeless AlPO₄-5 framework with the negatively charged framework (known as ZnAPO-34) that is formed by replacing Al³⁺ in AlPO₄-5 with Zn²⁺. The former contains one-dimensional channels, but the latter spherical cavities rather than channels. By employing not only small and wide angle X-ray scattering (SAXS and WAXS), but also X-ray absorption spectroscopy, it was possible to observe in real time both the structural changes in the aluminophosphate gel and the conformational features of the organic base (tetraethylammonium hydroxide) used as a template for the crystallization of zeolite. The tetraethylammonium ion was found to form a complex with developing zeolite sub-units in the gel, adopting a molecular structure close to that found in the final crystal. This molecular recognition process determines which type of crystal lattice is formed. The principal point here is that molecular organization takes place before

crystallization. The experiments were done at BM26A, ESRF (Grenoble, France). For more information, see the paper, *A Combined SAXS/WAXS/XAFS Setup Capable of Observing Concurrent Changes Across the Nano-to-Micrometer Size Range in Inorganic Solid Crystallization Processes*, A. M. Beale *et al.*, *J. Am. Chem. Soc.*, 2006; **128**: 12386. Another interesting account can also be found in *Physical chemistry: Porous solids get organized*, R. A. van Santen, *Nature*, 2006; **444**: 46.

PROFESSIONAL

Scientists from France, Germany and UK awarded 2007 Japan Prize (11 January, 2007)

The Science and Technology Foundation of Japan has announced that French, German and UK scientists have been named as laureates of the 2007 (23rd) Japan Prize. Prof. Albert Fert, 68, of France and Prof. Dr. Peter Grunberg, 67, of Germany, will receive the prize in this year's category of 'Innovative Devices Inspired by Basic Research.' They discovered the phenomenon of giant magneto-resistance (GMR) and contributed to the development of innovative spin-electronics devices. Dr. Peter Ashton, 72, of the UK has been selected in another prize category of 'Science and Technology of Harmonious Co-Existence.' They will receive certificates of merit, and commemorative medals. There is also a cash award of fifty million Japanese yen for each prize category. The prize categories for the 2008 (24th) Japan Prize will be 'Information Communication Theory and Technology' and the 'Medical Genomics and Genetics'. For further details of the Japan Prize, contact The Science and Technology Foundation of Japan. Phone: +81-3-5545-0551, Fax +81-3-5545-0554, info@japanprize.jp <http://www.japanprize.jp/English.htm>

NEW PRODUCTS

Compact soft X-ray microscope with 50 nm resolution (16 January, 2007)

JMAR Technologies, Inc. has announced that it has successfully hit the 50 nm resolution milestone targeted in the development of its soft X-ray microscope, which bridges the sizeable gap between optical microscopes and transmission electron microscopes. Key advantages include the ability to provide not only 2D images, but full 3D tomographic reconstructions without physical slicing. For further information, contact Dennis Valentine, Chief Financial Officer. Phone: +1-858-946-6800, <http://www.jmar.com/2004/index.shtml>

Sarnoff Imaging Systems' new linear CCD (16 January, 2007)

Sarnoff Imaging Systems has released its 8k linear CCD sensors for standalone purchase. The company also plans to offer camera modules for companies that do not require a custom-built camera. The front-illuminated CCD sensor features eight output ports, each running at speeds of up to 19MHz and a 17kHz line rate. For further information, visit <http://www.sarnoffimaging.com/>

Agilent Technologies releases new software for X-ray inspection (3 January, 2007)

Agilent Technologies Inc. has announced the release of its 8.4 software for the Medalist 5DX Automated X-ray Inspection (AXI) system. The main benefits are expected in the inspection of quad-flat no-lead (QFN) and defect characterization on non-wetted direct FET. For further information, contact Janet Smith, Phone: +1-970-679-5397, janet.smith@agilent.com, <http://www.agilent.com/>

Sydor's new X-ray streak camera (21 December, 2006)

Sydor Instruments, LLC has announced that the new Sydor ROSS X-Ray Streak Camera is to be presented for the first time at Photonics West 2007 (San Jose, CA, USA, January 23-25, 2007). Sydor Instruments is the only commercial supplier of the ROSS (Rochester Optical Streak System) technology, which has been developed under an exclusive license from the University of Rochester, Laboratory for Laser Energetics. For further information, call +1-585-427-9112 or visit <http://www.sydorinstruments.com>

Hecus XRS launches point-focus X-ray camera (18 December, 2006)

Hecus X-Ray Systems GmbH has announced the launch of S3-MICRO, an X-ray camera system for nanostructure analysis. The system is powered by GeniX (developed by Xenocs, Grenoble, France), a high brilliance X-ray beam delivery system that uses a low power 50 W micro focus source. For further information, call +43-316-4811-180, Fax: +43-316-4811-1820, office@hecus.at, <http://www.hecus.at>

CORPORATE

e2V opens new Asia Pacific office (18 January, 2007)

e2v has announced the expansion of its sales and support offices with the opening of its new Asia Pacific office in Hong Kong. For further information, call Andy Bennett, Phone: +44 1245 453296, andy.bennett@e2v.com, <http://www.e2v.com/>

Kodak sells X-ray division (10 January, 2007)

Eastman Kodak Co. is selling its health-imaging business, created after the discovery of X-rays in 1895, to Canadian investment firm Onex Corp. for up to \$2.55 billion. The deal, expected to close in the first half of the year, includes a significant portion of Kodak's plant in Windsor as well as facilities in other cities. For further information, visit <http://www.kodak.com/>

OMRON launches X-ray business in alliance with UNI HITE System (10 January, 2007)

OMRON, Kyoto, Japan, recently announced that the company will collaborate with UNI-HITE System, and will start developing a 3D X-ray inspection machine mainly for package solder applications. For further information, call Osamu Harasawa, Phone +81-3-3779-9434, or visit <http://www.omron.com/>

NEWS

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X-ray spectroscopy supports the hypothesis of how pigeons find their way home (14 March, 2007)

It has long been believed that birds can in some way use the natural magnetism of the earth to navigate. Recently, scientists from the University of Frankfurt employed micro X-ray fluorescence as well as micro XAFS spectroscopy to analyze the skin of the upper beak of homing pigeons. Within the skin lining, they established the existence of tiny maghemite ($\gamma\text{-Fe}_2\text{O}_3$) and magnetite (Fe_3O_4) particles (with a ratio of around 9:1) in the dendritic nerve branches that were arranged in a 3D pattern. According to the research team, this strongly supports the theory that the upper beak of pigeons houses a highly sensitive magneto-receptor that can be used for navigation. The experiments were done with synchrotron X-rays at HASYLAB in Hamburg, Germany. For more information, see the paper, 'A novel concept of Fe-mineral-based magnetoreception: histological and physicochemical data from the upper beak of homing pigeons', G. Fleissner *et al.*, *Naturwissenschaften*, published online in mid-March, 2007.

X-ray laser pulses snapshot the motion of Bismuth atoms in sub-picosecond resolution (2 February, 2007)

The Sub-Picosecond Pulse Source (SPPS) is a prototype X-ray free electron laser built using the 2-mile-long linear accelerator at Stanford Linear Accelerator Center (SLAC), California, USA. To date, ultrafast phenomena have been mainly studied with femtosecond lasers operating at ultraviolet to infrared wavelengths; however, these wavelengths are not short enough for structural studies on atomic distances. Therefore, the emergence of short pulse laser in the hard X-ray region represents a significant challenge. Recently, at Stanford, an international collaborative team from 20 different institutions succeeded in observing the atomic motion of Bismuth crystal, which, although cubic, has a slight elongation along the diagonal called a Peierls distortion. The measurements have brought new fundamental insights into the dynamics of the material, which shows very strong coupling between the electronic and ionic structures. The results could also be used to screen many theoretical calculations made so far. For more information, see the paper, 'Ultrafast Bond Softening in Bismuth: Mapping a Solid's Interatomic Potential with X-rays', D. M. Fritz *et al.*, *Science* 2007; 315:633.

Another step towards shorter and brighter pulses: first successful observation of superradiance in FEL (19 January, 2007)

At Brookhaven National Laboratory, USA, researchers have recently found a novel way to generate a very short controllable free electron laser (FEL) pulse, which usually depends on the length of the electron pulse. The main idea is the use of a Ti:Sapphire laser that combines a 150 femtosecond (FWHM) pulse of light with the much longer electron beam. This leads to a femtosecond FEL pulse that keeps growing in intensity and shortening in time duration, which is attributed to a phenomenon called *superradiance* (for details, see, R. H. Dicke, *Phys. Rev.* 93, 99 (1954)). The present research is the first to experimentally observe the effects of superradiance in a FEL setup. The output FEL pulse duration was measured to be as short

as 81 femtoseconds, a roughly 50% reduction compared to the input seed laser. Understanding how to produce these intense, ultrafast pulses of light could help scientists around the world as they begin to construct the next generation of light source facilities. For more information, see the paper, 'Experimental Characterization of Superradiance in a Single-Pass High-Gain Laser-Seeded Free-Electron Laser Amplifier', T. Watanabe *et al.*, *Phys. Rev. Lett.* 2007; 98:034802.

Lensless X-ray microscopy (18 January, 2007)

Professor J. Rodenburg and his colleagues from the University of Sheffield, UK and the Paul Scherrer Institute, Switzerland, recently developed a novel X-ray microscope. This is very different from conventional microscopes developed so far, because it does not employ any optics to focus the beams. The lensless technique collects diffraction patterns from several overlapping areas in space, which provides information about how the rays interfere with each other after they have been diffracted through the object. This interference can then be calculated backwards to what the rays' previous phase changes must have been, giving a complete picture of the structure. Since this innovative technique relies on a special type of computation (called ptychographical iterative engine (PIE), for details, see H. M. L. Faulkner and J. M. Rodenburg, *Phys. Rev. Lett.* 2004; 93:023903, rather than specific equipment, it could also be used to boost the power of optical and even electron microscopes. For more information, see the paper, 'Hard-X-Ray Lensless Imaging of Extended Objects', J. M. Rodenburg *et al.*, *Phys. Rev. Lett.* 2007; 98:034801.

Atomic structure of complex quasicrystals (1 January, 2007)

Icosahedral quasicrystals (i-QCs) are long-range ordered solids that show non-crystallographic symmetries such as five-fold rotations. Their detailed atomic structures are still far from completely understood, because most stable i-QCs form as ternary alloys suffering from chemical disorder. Recently, a French-Japanese collaborative team led by Professor A. P. Tsai (Tohoku University, Japan) has succeeded for the first time in obtaining a detailed structure solution for i-YbCd_{5.7}. Similar to normal crystals, i-QCs exhibit beautiful diffraction patterns, but their lack of periodicity prevents conventional analysis. However, mathematically, i-QCs can be seen as the projection in 3D of a structure that is periodic in a virtual space of higher dimension. This resolves the situation because it allows conventional crystallography to be used in the higher-dimensional space. The obtained result represents an essential starting point for finding the atomic structure of more complex i-QCs. The team's X-ray experiments were done with synchrotron X-rays at D2AM beamline, ESRF in Grenoble, France. For more information about the analysis, see the paper, 'Atomic structure of the binary icosahedral Yb-Cd quasicrystal', H. Takakura *et al.*, *Nature Materials*, 2007; 6:58–63.

PROFESSIONAL

First research projects started at Diamond (6 February, 2007)

Diamond Light Source, in the UK, has opened its doors for business and welcomed its very first scientific users -

top academic teams from Durham, Oxford, Leicester and London, selected from a total of 127 proposals. These first research projects will be carried out in beamlines that are part of Phase I (the synchrotron machine itself and the first seven beamlines). For more information about Diamond Light Source contact: Isabelle Boscaro-Clarke at Diamond: +44 1235 778130/+44 7990 797916/isabelle.boscaro-clarke@diamond.ac.uk, <http://www.diamond.ac.uk>

First meeting of future XFEL users in Hamburg (27 January, 2007)

260 scientists from 22 countries gathered on January 24–25 at the DESY research center in Hamburg, Germany for the first European XFEL Users Meeting which brought together the future users of the European X-ray laser facility. The first users' meeting marks the beginning of a series of regular workshops and meetings between the scientists interested in the research opportunities at the XFEL and the planners of the facility. For more information, contact Petra Folkerts, Press officer XFEL project, FLASH, DESY, Phone: +49-40-8998-4977, Fax: +49-40-8998-2020, petra.folkerts@desy.de, <http://www.xfel.net>

NEW PRODUCTS

PGT releases new model of LaBr₃ scintillation detector (7 March, 2007)

Princeton Gamma-Tech (PGT) has announced the release of its new Model 2100LA, which is a scintillator-based spectroscopy system with a LaBr₃ detector, electronics and software. The detector is used with a multi-channel analyzer, and the energy resolution is 2.5%. The detector works at room temperature. For further information, contact Rich Varall, Princeton Gamma-Tech, Phone: +1-(609)924-7310 ext. 306, nuclearsales@pgt.com, <http://www.pgt.com>

JEOL starts distributing a new thermal field emission SEM (7 February, 2007)

JEOL Ltd. has announced the release of its new thermal field emission scanning electron microscope (SEM), JSM-7001F, which characterizes nanostructures with a resolution of 1.2nm at 30kV. This new SEM permits high-resolution micrographs at up to 1,000,000x for applications ranging from semiconductors, metals, minerals, materials, and ceramics, to non-conductive biological samples. For further information, contact JEOL Ltd., 1-2, Musashino 3-chome Akishima, Tokyo 196-8558, Japan, Phone: +81-42-543-1111, Fax +81-42-546-3353, <http://www.jeol.com>

Oxford Instruments launches new hand-held XRF analyzer (5 February, 2007)

Oxford Instruments has launched a new fast, lightweight, hand-held XRF analyzer. The X-MET3000TX+ is configured for producing fast and accurate analysis of metals for the recycling industry and for reliable Positive Material Identification (PMI) in the metal fabrication and process industries. For further information, contact Oxford Instruments Corporate Communications Manager, Lynn

Shepherd, lynn.shepherd@oxinst.co.uk, <http://www.oxford-instruments.com/wps/wcm/connect/Oxford+Instruments/Internet/Home/>

CORPORATE

USA subsidiary SPECTRO Analytical Instruments, Inc. moves to new facility (25 March, 2007)

SPECTRO USA has moved from its Marlborough Massachusetts facility to a new facility in Mahwah New Jersey. The new contact details are SPECTRO Analytical Instruments, Inc., 91 McKee Drive Mahwah, NJ 07430 USA, Phone: +1-800-548-5809, +1-201-642-3000, Fax (Service): +1-201-642-3092, Fax (Sales): +1-201-642-3091, info@spectro-usa.com

Shimadzu strengthens X-ray spectrometer sales business in North America (12 March, 2007)

Shimadzu Scientific Instruments, Inc. (SSI) has announced the transfer of the X-ray spectrometer business from Kratos Analytical, a wholly owned subsidiary of Shimadzu Corporation, to SSI. Effective April 1, SSI will handle sales, service, and technical support for current and future customers of Shimadzu's X-ray spectrometers in the United States, Canada, and Mexico. For further information, contact Shimadzu Scientific Instruments, 7102 Riverwood Drive, Columbia, MD 21046, USA, Phone: +1-800-477-1227, Fax: +1-410-381-1222, Email: kgmclaughlin@shimadzu.com, <http://www.ssi.shimadzu.com/>

Xradia raises \$7 million in venture capital funding led by Harris & Harris Group (7 March, 2007)

Xradia Inc. has raised \$7.0 million by offering equity in exchange for financing. Major investors included Harris & Harris Group, Inc., an unnamed strategic investor, and an investor from a prior round of financing. Xradia designs, manufactures and sells a suite of ultra high resolution 3D X-ray microscopes and fluorescence imaging systems capable of nondestructive imaging of internal structures at the micrometer and nanometer scale. The company has experienced rapid revenue growth over the last two years and achieved profitability in 2006. For further information, Phone: +1-925-288-1228, Fax: +1-925-288-0310, sales@xradia.com, <http://www.xradia.com/>

e2v supplies IOTs for UK Diamond synchrotron facility (14 February, 2007)

e2v technologies plc has announced that it has supplied four IOTD2130 inductive output tubes (IOTs) for the new Diamond Light Source synchrotron based in Oxfordshire, UK. The tubes are to be installed into the synchrotron's storage ring RF system, providing a combined RF power of 300kW under continuous wave (CW) conditions. The company has a track record of supplying klystrons to the scientific community. In May 2005, e2v was selected to supply CW klystrons for Cornell University's prototype energy-recovery linear accelerator (ERL), an advanced synchrotron radiation machine. For further information, call Andy Bennett, Phone: +44 1245 453296, andy.bennett@e2v.com, <http://www.e2v.com/>

NEWS

SCIENCES

X-ray reveals that metal-free carbon could become magnetic at room temperature (3 May, 2007)

For many years, the existence of magnetic carbon has remained an enigma. Previous claims to have solved the mystery were subsequently disproved when it was found that magnetic metals like iron, nickel, etc., were probably present in the carbon samples. Recently, Dr Ohldag (Stanford Synchrotron Radiation Laboratory) and his colleagues have shown that pure carbon can be made permanently magnetic at room temperature after carrying out a series of careful measurements including scanning transmission X-ray microscopy, X-ray magnetic circular dichroism (XMCD), PIXE analysis (to check for contamination by magnetic metals), AFM, and MFM etc. The team found that the magnetic order originates only from the carbon π -electron system. For more information, see the paper, ' *π -Electron Ferromagnetism in Metal-Free Carbon Probed by Soft X-Ray Dichroism*', H. Ohldag *et al.*, *Phys. Rev. Lett.*, 2007; 98: 187204.

Coherent X-ray speckle pattern of antiferromagnets: First results (3 May, 2007)

Recently, some very interesting research on magnetic noise from antiferromagnets has been published. Unlike ferromagnets, the characteristics of which have been studied for many years, antiferromagnets have remained a mystery because their internal structure was too fine to be measured. Their internal order is on the same scale as the wavelength of X-rays, and therefore, X-ray photon correlation spectroscopy, which measures 'speckle' patterns, can give a unique 'fingerprint' of a particular magnetic domain configuration. It was found that the domain wall motion is thermally activated at temperatures above 100 K, but not so at lower temperatures. For more information, see the paper, '*Direct measurement of antiferromagnetic domain fluctuations*', O. G. Shpyrko, *et al.*, *Nature* 2007; 447: 68.

Towards attosecond — observation of electron tunnelling (5 April, 2007)

Atoms become ions when exposed to extremely intense light. The process is predicted to occur via tunnelling through the binding potential that is suppressed by the light field near the peaks of its oscillations. Professor F. Krausz (Max Planck Institute of Quantum Optics in Garching, Germany) and his collaborators recently reported the real-time observation of this most elementary step in strong-field interactions, i.e., light-induced electron tunnelling. The team used 250-attosecond pulses of UV radiation, and confirmed theoretical predictions about the tunneling process. It was also found that the process lasted for several hundred attoseconds, depleting atomic-bound states. This would suggest that the use of tunneling itself is feasible for probing short-lived, transient states of atoms or molecules, e.g., multi-electron excitation (shake-up) and relaxation (cascaded Auger decay) processes etc. For more information, see the

paper, '*Attosecond real-time observation of electron tunnelling in atoms*', M. Uiberacker *et al.*, *Nature*, 2007; 446: 627.

PROFESSIONAL

Obituary — Theodore H. Maiman (5 May, 2007)

Theodore H. Maiman, the American physicist who made the first working laser, died on 5 March, 2007 at the age of 79 from systemic mastocytosis in Vancouver, Canada, where he lived with his wife. Maiman's laser, based on a synthetic ruby crystal grown by Dr. Ralph L. Hutcherson, was first operated on 16 May 1960 at Hughes Research Laboratories in Malibu, California. It is well-known that this breakthrough was based on the idea of employing artificial rubies as the active medium for the laser at a time when others were trying only various gases. Dr. Maiman would have been aware of errors in their calculations. Another key point is that he also used pulses of light to excite atoms in the ruby. This was the ground-breaking first step to the modern pulse laser. Although his paper on this wonderful discovery was unfortunately mistakenly rejected by *Physical Review Letters*, the shortened version was published in *Nature* ('*Stimulated Optical Radiation in Ruby*', T. H. Maiman, *Nature*, 187, 493 (1960)). Dr. Maiman received the Japan Prize in 1987. He is the author of a book entitled '*The Laser Odyssey*' (Laser Press, 2000). The New York Times (11 May, 2007) carries an obituary written by Douglas Martin.

Nanocenter opened at Brookhaven National Laboratory (1 May, 2007)

The Center for Functional Nanomaterials (CFN) has opened at Brookhaven National Laboratory, United States. The CFN is dedicated to the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions. The science at the CFN is organized around three scientific themes; (i) nanocatalysis, (ii) biological and soft nanomaterials, and (iii) electronic nanomaterials. The official opening ceremony will be held on 21 May. For more information, visit <http://www.bnl.gov/cfn/>

First set of experiments at SOLEIL (22 March, 2007)

Recently, at the new French synchrotron facility, SOLEIL, the first experimental results have been obtained in spite of the technically difficult situation that is still preventing the beamline from functioning under normal operating conditions. The absorption spectroscopic experiments were done on a kidney stone, which is an agglomerate of many different nanometer-scale crystalline materials. For more information on the recent status of SOLEIL, visit <http://www.synchrotron-soleil.fr/>

2007 Benjamin Franklin Medal (12 March, 2007)

The 2007 Benjamin Franklin Medals recipients have been announced as follows; Chemistry, Klaus Biemann (Professor Emeritus, Department of Chemistry, Massachusetts Institute

of Technology), Earth and Environmental Science, Steven W. Squyres (Goldwin Smith Professor of Astronomy, Cornell University), Electrical Engineering, Robert H. Dennard (IBM Fellow, Silicon Technology Department, IBM Research Division), Life Science, Nancy S. Wexler (Higgins Professor of Neuropsychology, College of Physicians and Surgeons of Columbia University), Materials Engineering, Merton C. Flemings (Director, Lemelson Program-MIT Program, Massachusetts Institute of Technology), Physics, Yoji Totsuka (Former Director-General High Energy Accelerator Research Organization, Japan), and Arthur McDonald (Director, Sudbury Neutrino Observatory Institute, Queen's University, Canada). For more information on Benjamin Franklin Medals, visit <http://www.fi.edu/tfi/exhibits/bower/>

NEW PRODUCTS

Shimadzu releases SMX-3000micro — an X-ray inspection system with a flat-panel detector (9 May, 2007)

Shimadzu has announced the release of the SMX-3000micro, an X-ray inspection system suitable for the auto industry, equipped with a 130 kV micro focus X-ray source and a flat-panel detector. It costs 19,600,000 JPY. For further information, Phone: +81-3-3219-5641, Fax: +81-3-3219-5710, imdsci05@shimadzu.co.jp

Agilent unveils in-line 3D X-ray inspection system (23 April, 2007)

Agilent Technologies Inc. has announced the release of the Agilent Medalist x6000, a new in-line 3D X-ray inspection system for the detection of printed circuit board assembly solder and manufacturing assembly defects. Throughput has been improved to almost double that of the previous machine. Product photos are available at <http://www.agilent.com/find/x6000.images>. For further information, contact Janet Smith, Phone: +1-970-679-5397, janet_smith@agilent.com

JEOL releases JSX-3100RII — an energy-dispersive XRF analyzer with liquid nitrogen-free system (23 April, 2007)

JEOL Ltd. has announced the release of the JSX-3100RII as a successor to the JSX-3100R, an energy-dispersive XRF analyzer distributed as a solution for screening materials in order to meet the RoHS Directive. The main advantage of the JSX-3100RII is its electronic cooling system, which means that liquid nitrogen is no longer required. The new product costs 12,300,000 JPY. For further information, contact JEOL Ltd., 1-2, Musashino 3-chome Akishima, Tokyo 196-8558, Japan, Phone: +81-42-543-1111, Fax: +81-42-546-3353, <http://www.jeol.com>

Rigaku announces ultra-bright microfocus X-ray source for structural biology (28 March, 2007)

Rigaku Americas Corporation has announced the introduction of the Rigaku FR-E+ SuperBright™, a microfocus

rotating anode X-ray source for structural biology. The focus size is 70µm×70µm, and the flux intensity is 1.6×10¹¹ photons/mm²/sec, almost twice that of rival instruments. The X-ray source is particularly suitable for the tiny crystals typically encountered in current structural biology research. For high-throughput phasing applications, several dual wavelength configurations, including a Cu/Cr configuration, are available. Other technical details can be found at <http://www.rigaku.com/generators/fre-plus.html> For further information, contact Joseph D. Ferrara, Phone: +1-281-362-2300, joseph.ferrara@rigaku.com

CORPORATE

CANBERRA subsidiary opens in Sweden (1 May, 2007)

CANBERRA has announced the creation of a subsidiary in Sweden, by integrating the former Laborel employees and Uppsala premises in the new company. For further information, contact the CANBERRA Sweden team, Kungsgatan 107 - SE-753 18 Uppsala, Sweden, Phone: +46 18 14 83 00, Fax: +46 18 14 83 01, info.se@canberra.com

Oxford Instruments receives Queen's Award (21 April, 2007)

Oxford Instruments has been awarded The Queen's Award for Enterprise for the development of INCADryCool, a liquid nitrogen-free EDS X-ray detector. Technical details of INCADryCool are available at the following Web page, <http://www.oxford-instruments.co.uk/wps/wcm/resources/file/ebf5250f4189310/INCADryCool.brochure.pdf> For more information, contact Lynn Shepherd, Corporate Communications Manager, lynn.shepherd@oxinst.co.uk, <http://www.oxford-instruments.co.uk/>

Willis and Duncan XRF course moves to PANalytical (19 April, 2007)

PANalytical has acquired the rights to the renowned 'Willis & Duncan' course, a long-established education and training program for advanced X-ray fluorescence analysis. This famous course has been organized by Professors James Willis and Andy Duncan since 1974 at the University of Cape Town, South Africa. For further information, Phone: +31-546-534444, Fax: +31-546-534592, info@panalytical.com, <http://www.panalytical.com>

XOS to directly market SINDIE bench-top analyzer in America (27 March, 2007)

XOS has announced changes to the sales and distribution, in North and South America, of its SINDIE line of bench-top sulfur analyzers for the petroleum industry. Until now, these analyzers have been distributed by Horiba Instruments Inc. For further information, contact XOS Sales Inquiries, 15 Tech Valley Drive, East Greenbush, NY 12061, Phone: +1-518-880-1501, sales@xos.com, <http://www.xos.com>

NEWS

“Handbook of Practical X-ray Fluorescence Analysis” (B. Beckhoff, B. Kanngießer, N. Langhoff, R. Wedell and H. Wolf (Eds.), Springer-Verlag Berlin Heidelberg 2006, ISBN-10 3-540-28603-9)

The first impression one gets from looking at this book is that it is quite thick and looks heavy, and indeed, a wealth of information on modern XRF is densely packed into its 863 pages. In all, 69 scientists, mainly from Europe but also several from North America, South Africa and Japan have contributed articles on various aspects of the XRF technique; elements of XRF instruments, i.e., X-ray source (Chap. 2), optics (Chap. 3) and detector technologies (Chap. 4), as well as know-how regarding sample preparation (Chap. 6) and many applications (Chap. 7 and others). One of the most impressive sections of this book is ‘Quantitative Analysis’ (Chap. 5) authored by M. Mantler, J. P. Willis, G. R. Lachance, B. A. R. Vrebos, K. E. Mauser, N. Kawahara, R. M. Rousseau and P. N. Brower. The chapter provides a good summary of each historically developed mathematical expression and discusses the issues related to errors and reliability, as well as standardization, which is significant in practical analysis. The intensity of XRF correlates to the concentration of the corresponding element, but also depends on the matrix, i.e., concentration of other elements. However, thanks to the well-established physical basis of XRF, calculations can explain measured XRF spectra to some extent. In modern practical analysis, the most likely difficulty to be encountered is in preparing so-called ‘standard samples’ that have the same matrix of the unknown sample to be analyzed. In such cases, one might wonder how one can depend on calculations, or which type of experimental data would help. Such problems are not new, but have yet to be fully resolved. They are also likely to assume even greater importance in the future. The book includes numerous stimulating applications in the area of micro area analysis with X-ray microbeams and ultra trace analysis using the total reflection condition (Chap. 7). The use of synchrotron radiation contributed to pushing those techniques to state-of-the-art levels, and development of such techniques is still in progress. The book delves into XRF instrumentation and seems particularly strong in X-ray optics (Chap. 3). One can learn about the latest technological advances in great detail. Progress in this area correlates to the advent of new sources, like synchrotrons and micro-focus laboratory X-ray sources. Finally, in the last three pages, Chap. 8.2, there is a very useful list of sources and links, i.e., URLs, book names etc. In short, owing to its sheer practicality, every X-ray laboratory should have a copy of the handbook, or even two or three.

SCIENCES

Theoretical prediction of electromagnetically induced transparency for X-rays (June 22, 2007)

Electromagnetically induced transparency (EIT) is a coherent optical nonlinearity, and brings dramatic changes in optical properties such as absorption, emission, refraction etc. The

phenomena relate to the quantum mechanical overlapping state created by two different wavelengths of coherent light. Recently, EIT for X-rays has been theoretically predicted. According to the theory, it is possible to make Ne gas, which is normally opaque, transparent by exposing it to laser light of 800 nm with extremely high flux of 10^{12} W/cm². The scheme could be used for producing ultra-short X-ray pulses. For more information, see the paper, “*Electromagnetically Induced Transparency for X Rays*”, C. Buth et al., Phys. Rev. Lett., **98**, 253001 (2007). For more about general EIT, see, for example, “*Electromagnetically Induced Transparency*”, S. Harris, Physics Today, **50**, 36–42 (1997).

X-ray spectroscopy aids understanding of how magnetic refrigeration works (June 15, 2007)

Scientists at Argonne National Laboratory and Ames Laboratory, Iowa State University, have recently performed X-ray magnetic circular dichroism (XMCD) measurements of giant magnetocaloric material, Gd₅(Ge_{1-x}Si_x)₄. It was found that germanium becomes magnetic by spin-dependent hybridization between Ge 4p and Gd 5d. This hybridization can change at the germanium-silicon bond-breaking transition, causing the destruction of magnetic ordering and leading to the giant magnetocaloric effect. By combining the experimental results with calculations based on density functional theory, it was concluded that the magnetized germanium orbitals act as “magnetic bridges” in mediating the magnetic interactions across the distant gadolinium ions. For more information, see the paper, “*Role of Ge in Bridging Ferromagnetism in the Giant Magnetocaloric Gd₅(Ge_{1-x}Si_x)₄ Alloys*”, D. Haskel et al., Phys. Rev. Lett., **98**, 247205 (2007).

Femtosecond-laser-driven X-ray source with 12 micron size and flux of 1,200 photons/mrad²/pulse (May 22, 2007)

A research group at the Japan Atomic Energy Agency (Kizugawa, Japan) has recently developed a novel table-top pulsed X-ray source. The source employs a Ti:sapphire laser, emitting 70 fs duration 2 TW pulses of 800 nm wavelength at 10 Hz. The laser beam is focused to the flow of high-density Ar gas. The source was applied to perform phase contrast imaging. For more information, see the paper, “*Phase-contrast x-ray imaging with intense Ar K α radiation from femtosecond-laser-driven gas target*”, L. M. Chen et al., Appl. Phys. Lett. **90**, 211501 (2007).

PROFESSIONAL

DOE advances NSLS-II project (July 17, 2007)

The Department of Energy (DOE) in the US granted “Critical Decision 1” (CD-1) status to the National Synchrotron Light Source-II (NSLS-II), which will be a new medium energy storage ring and will replace the existing NSLS which began operations in 1982. This decision assures the facility’s location at Brookhaven National Lab. For more about the NSLS-II project, visit the Web page, <http://www.bnl.gov/nsls2/>

First NIMS Award — W. H. Butler (July 11, 2007)

The National Institute for Materials Science, Japan, has announced that the first NIMS Award for recent breakthroughs in materials science and technology has been presented to Professor William H. Butler (Center for Materials for Information Technology, University of Alabama, USA) for the theoretical prediction of giant tunnel magnetoresistance (TMR). Professor Butler performed the first principle calculation on tunnel conductance through MgO(001) single crystal thin film, and theoretically predicted the giant TMR effect of the Fe(100)/MgO/Fe(100) junction for the first time. A giant TMR effect beyond ~500% has now been realized, which is expected to make a substantial contribution to the development of novel spintronics devices and the creation of a new interdisciplinary field.

2007 Compton Award — A. Joachimiak & G. Rosenbaum (May 7, 2007)

The Advanced Photon Source (APS) and APS Users Organization has announced that the 2007 Arthur H. Compton Award has been presented jointly to Andrzej Joachimiak and Gerold Rosenbaum of Argonne National Laboratory for pioneering advances and leadership that helped to establish the APS as a premier location worldwide for protein crystallography research. Former recipients of the award are: Gunter Schmahl and Janos Kirz (2005), Martin Blume, Doon Gibbs, Kazumichi Namikawa, Denis McWhan (2003); Wayne A. Hendrickson (2001); Sunil K. Sinha (2000); Donald H. Bilderback, Andreas K. Freund, Gordon S. Knapp, Dennis M. Mills (1998); Philip M. Platzman, Peter M. Eisenberger (1997); Nikolai Vinokurov, Klaus Halbach (1995). For more information, contact Eleanor Taylor, Phone, +1-630-252-5565, etaylor@anl.gov

NEW PRODUCTS

PANalytical's new Axios-Minerals XRF package for elemental analysis of blast furnace slag (July 10, 2007)

Slag has many applications in the construction industry. Reliable and repeatable analysis of the elemental composition of slag is essential for process control and to assess its suitability for specific applications. PANalytical has announced that its Axios-Minerals wavelength dispersive XRF (WDXRF) spectrometer has overcome the need for reference materials to calibrate the system, because it now includes a set of multi-element wide-range oxide (WROXI) standards and the SuperQ Fundamental Parameters (FP) calibration model. For further information, Phone: +31-546-534444, Fax: +31-546-534592, info@panalytical.com, <http://www.panalytical.com/>

Oxford's X-MET3000TXV+ — a new handheld XRF analyzer for quick sorting of high-value alloys in metal recycling (June 19, 2007)

Oxford Instruments has launched a new portable XRF analyzer, X-MET3000TXV+, which is equipped with a vacuum pump and now covers the measurement of silicon and magnesium in aluminum and the aluminum in titanium

alloys that were previously not measurable with portable XRF instruments. For further information, Phone: +44-1494 442255, Fax: +44-1494 461033, analytical@oxinst.co.uk, <http://www.oxford-instruments.com/>

Thermo Fisher Scientific launches 3rd-generation handheld NITON XRF analyzers (June 3, 2007)

Thermo Fisher Scientific Inc. has announced the launch of the Thermo Scientific NITON XL3 Series, which is suitable for solder alloy grade identification and laboratory-quality composition analysis of plastics and polymers. The typical time for routine solder screening measurements is less than 5 sec, or twice as fast as previous-generation NITON instruments. The NITON XL3t is equipped with a 50 kV, 2-W X-ray tube, the most powerful X-ray tube ever offered in a handheld XRF analyzer. For further information, contact Jennifer Robert, Phone: +1-978-670-7460 Ext. 392, Jen.Robert@thermofisher.com, <http://www.thermo.com/niton>

CORPORATE

Shimadzu and Fujifilm ally in medical digital X-ray imaging market (July 4, 2007)

In Japan, Shimadzu Corporation and Fujifilm Corporation have announced an alliance in the medical X-ray imaging market. Both companies will exchange products—X-ray sources and flat-panel detectors in the case of Shimadzu, and image processors and software in the case of Fujifilm—with a view to developing future generation medical inspection instruments. For further information, Phone: +81-3-6271-2000 (Fujifilm), <http://www.fujifilm.com/>, or Phone: +81-3-3219-5641 (Shimadzu), <http://www.shimadzu.com/>

Xradia delivers hard X-ray nanoprobe microscope to Argonne National Lab (June 22, 2007)

Xradia, Inc. has announced the delivery of the first hard X-ray nanoprobe instrument (nanoPi), which has been developed together with Argonne National Laboratory's Center for Nanoscale Materials (CNM). The nanoPi delivers high resolution of better than 30 nm at hard X-ray energies for elemental and structural analysis using scanning probe and full-field transmission X-ray microscopy. The nanoPi has been installed at the hard X-ray Nanoprobe Beamline (ID-26) at Argonne's Advanced Photon Source (APS). For further information, Phone: +1-925-288-1228, Fax: +1-925-288-0310, sales@xradia.com, <http://www.xradia.com/>

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For additional news about X-ray analysis and other spectroscopy sciences, please browse the Wiley website. <http://www.SpectroscopyNow.com>

Kenji Sakurai

News Editor

sakurai@yuhgiri.nims.go.jp
or sakurai@pas.tsukuba.ac.jp

NEWS

SCIENCES

X-ray spectroscopy at high pressure and temperature helps in locating mantle's spin transition zone (September 21, 2007)

Generally, the structure, composition, and dynamics of the Earth's lower mantle are influenced by the electronic state of iron within minerals at high pressure and temperature. For instance, if this electronic state leads to a change in the density of minerals, it would alter the travelling velocity of sound waves. Dr. Jung-Fu Lin (Lawrence Livermore National Laboratory, California, USA) and his colleagues recently determined the spin state of iron in ferroperricite [(Mg_{0.75}, Fe_{0.25})O] at lower-mantle pressures and temperatures using an X-ray emission spectrometer with *in-situ* synchrotron X-ray diffraction in a laser-heated diamond cell. They found that the transition between high and low spin happens at temperatures ranging from 1,900 to 2,300 K and pressures of up to 95 GPa: conditions found between 1,000 and 2,200 km below the surface. Through integrated absolute difference (IAD) analysis of FeK β spectra, they obtained the ratio of the high-spin to low-spin states in the sample. An energy shift of 1.6 eV in the main emission peak was interpreted as evidence of the spin transition. X-ray spectroscopists might find further significant spectral changes, e.g., K β' satellite, in their data. For more information, see the paper, "Spin Transition Zone in Earth's Lower Mantle", Jung-Fu Lin *et al.*, *Science*, **317**, 1740–1743 (2007).

A further pump-probe experiment: infra-red observation of N₂ molecules ionized by ultra-short soft X-ray pulses (September 7, 2007)

X-rays have been used as a tool for probing atomic-scale structures. Used in combination with pump by laser (usually from the infra red to visible light region), time-resolved X-ray (or soft X-ray) analysis is pushing back the frontiers in the world of materials. Recently, a further way of performing pump-probe experiments, i.e., an X-ray pump and infra-red probe, has been successfully applied to clarify the dynamics of N₂ molecules. A research team led by Professors H. Kapteyn and M. Murnane (University of Colorado, Boulder, USA) employed 43 eV soft X-rays with ca. 5 fs pulse width, which are laser-generated high-order harmonics, and an intense IR laser pulse (1.5 eV, 30 fs, 10¹³ W/cm²). The team found that substantial fragmentation occurs through an electron-shakeup process, in which a second electron is simultaneously excited during the soft X-ray photoionization process. During fragmentation, the molecular potential seen by the electron changes rapidly from nearly spherically symmetric to a two-center molecular potential. For more information, see the paper, "Soft X-ray-Driven Femtosecond Molecular Dynamics", E. Gagnon *et al.*, *Science*, **317**, 1374–1378 (2007).

Ultra fast holography with 32.5nm soft X-rays from FLASH, Hamburg (August 9, 2007)

Dr. H. Chapman (Lawrence Livermore National Laboratory, USA) and his colleagues recently published their new imaging technique, which is a new type of X-ray holography, and some successful data obtained at the free electron laser source, FLASH, Hamburg, Germany. Their technique employs soft X-ray laser pulses which pass through a small hole in a detector mirror, and then encounter a thin, translucent membrane that has been covered with a sample material (140 nm-diameter polystyrene balls) lying just in front of a backing mirror. In the present case, the X-ray pulse is shorter than the time spent traveling through the sample to the backing mirror and then returning. The sample is exploded by extremely strong X-ray photons and its size changes in the brief interval that the pulse takes to reflect back. The time it takes the pulse to return is encoded in the fringe pattern of the X-ray hologram, and this can be read out from the hologram to an accuracy of about one femtosecond. The spatial resolution is 50 nm in this experiment, but this will be further improved by shorter wavelength laser pulses. Their newly developed method opens up new opportunities for structure sciences based on holography, interferometry or coherent diffraction, as well as for studies that investigate the femtosecond dynamics of matter in new ways. It is interesting that the scientists were inspired by Isaac Newton, who noticed in the 18th century that sunlight produced "strange and surprising" light and dark bands on a screen after he had bounced it off a mirror speckled with dust particles. For more information, see the paper, "Femtosecond time-delay X-ray holography", H. N. Chapman *et al.*, *Nature*, **448**, 676–679 (2007).

PROFESSIONAL

The 2nd Asada Award (September 18, 2007)

The recipient of the 2nd Asada Award, which is presented in memory of the late Professor Ei-ichi Asada (1924–2005) to promising young scientists in X-ray analysis fields in Japan, is: Dr. Hiromi Eba (Musashi Tech. Institute, "Site occupancy determination and magnetic evaluation of MnZn-ferrites using MnK β X-ray fluorescence spectra"). The ceremony was held in Kyoto, during the international conference on X-ray optics and microscopy (ICXOM 2007) and the 43rd Annual Conference on X-Ray Chemical Analysis, Japan.

APEC nanoscale measurement technology forum (September 7, 2007)

Since 2005, the APEC "Technological Cooperative Framework of Nano Scale Measurement and Analytical Methods" has been aiming to share the most recent advances in nanometer analytical and measurement methods from representatives of government, the private sector, R&D organizations and academia. To this end, the 2007 APEC nanoscale measurement forum was organized by Industrial Technology Research Institute (ITRI), Taiwan, and was held at Taipei,

on September 5-7, 2007. The invited speakers were as follows; Peter Hatto (IonBond Ltd., Chairman of ISO/TC 229), Chanchana Thanachayanont (National Metal and Materials Technology Center, Thailand), Wen-Li Wu (NIST, USA), Michael Garner (Intel, USA), Chih-Ming Ke (Taiwan Semiconductor Manufacturing Company), Aleksandar Stefanovic (PANalytical, Singapore), Sang-Hee Suh (Center for Nanostructured Materials Technology, Korea), Kenji Sakurai (NIMS, Japan), Laura E. Depero (University of Brescia, Italy), Chun Zhang (Nano and Advanced Materials Institute, Hong Kong), Keiji Takahata (AIST, Japan), and Keh-Chyang Leou (National Tsing Hua University, Taiwan). For further information, contact Wei-En Fu, Center for Measurement Standards, ITRI, Taiwan, Phone +886-3-573 2220, WeienFu@itri.org.tw, <http://www.nml.org.tw/en/APECNanoForum/>

Denver X-Ray Conference Awards (August 3, 2007)

The following awards were presented during the plenary session of the 56th Annual Denver X-Ray Conference:

1. The 2007 Barrett Award was presented to Sunil K. Sinha, University of California San Diego, La Jolla, CA
2. The 2007 Jenkins Award was presented to Ting C. Huang, Emeritus, IBM Almaden Research Center, San Jose, CA
3. The 2007 Distinguished Fellow Award was presented to Ting C. Huang, Emeritus, IBM Almaden Research Center, San Jose, CA
4. The 2007 Hanawalt Award was presented to Tamás Ungár, Eötvös University Budapest, Budapest, Hungary
5. There was no recipient for the 2007 Jerome B. Cohen Student Award.

Workshop on 'buried' interface science with X-rays and neutrons (July 24, 2007)

The 2007 workshop on 'buried' interface science with X-rays and neutrons was held at the Institute of Materials Research, Tohoku University, in Sendai, Japan, on July 22-24, 2007. The workshop was the latest in a series held since 2001; Tsukuba (December 2001), Niigata (September 2002), Nagoya (July 2003), Tsukuba (July 2004), Saitama (March 2005), Yokohama (July 2006), Kusatsu (August 2006) and Tokyo (December 2006). There are increasing demands for sophisticated metrology in order to observe multilayered materials with nano-structures (dots, wires, etc), which are finding applications in electronic, magnetic, optical and other devices. Unlike many other surface-sensitive methods, X-ray and neutron analysis is known for its ability to see even 'buried' function interfaces as well as the surface. It is highly reliable in practice, because the information, which ranges from the atomic to mesoscopic scale, is quantitative and reproducible. However, the method should be upgraded further to cope with more realistic problems in nano sciences and technologies. Current X-ray methods can give atomic-scale information for quite a large area on a scale of $\text{mm}^2\text{-cm}^2$. These methods can deliver good statistics for an average, but sometimes it is necessary to analyze a specific part in nano-scale rather than an average structure. In addition, there is a need to see unstable changing structures and related phenomena in order to understand more about the mechanism of the functioning of nano

materials. Quick measurements are therefore important. Furthermore, in order to apply the method to a more realistic and complex system, we need some visual understanding to discuss the relationship among the different structures that are present in the same viewing. Therefore, 2D/3D real-space imaging is important. Interpretation of roughness is another significant subject, while combination with grazing-incidence small angle scattering (GISAS) will become much more widespread than before. The use of coherent beams and several other new approaches are also significant. Leading senior academics in this field were invited as commentators, Professors J. Harada (Nagoya University & Rigaku Corporation), S. Kikuta (The University of Tokyo & JASRI) and J. Mizuki (JAEA). The invited speakers from Tohoku University in Sendai, workshop site, Professors K. Takanashi, M. Kawasaki and M. Yanagihara, talked about the hot topic of *spintronics*, and/or control of 'buried' magnetic interfaces. It was stressed that the use of techniques sensitive to specific interfaces is crucial in analyzing many unsolved problems in this field. The workshop proceedings will be published electronically in Journal of Physics: Conference Series, <http://www.iop.org/EJ/journal/1742-6596>.

Obituary - Albert Baez (March 20, 2007)

Albert V. Baez, the co-inventor of X-ray focusing optics, has died at the age of 94 in San Mateo County, Calif. Born in Puebla, Mexico, and raised in Brooklyn, Dr. Baez earned a bachelor's degree in mathematics from Drew University, a master's in math from Syracuse University and a Ph.D in physics from Stanford University. Dr. Baez was a physics professor at several universities, including the University of Redlands, Stanford, MIT, University of California, Berkeley, and Harvard. In 1948, while he was still a graduate student at Stanford, Baez and his supervisor, physics professor Paul Kirkpatrick, developed a grazing-incidence X-ray mirror for focusing optics, which has since been used in X-ray microscopes and X-ray telescopes all over the world. Recent technological advancements have taken their innovation to the state-of-the-art level, and X-ray microscopes with Kirkpatrick-Baez-type mirrors can now achieve a spatial resolution of less than 50 nm. Professor Baez switched from experimental physics during the cold war to a career in physics education. In 1951, he worked for the United Nations Educational, Scientific and Cultural Organization, moving with his family to Iraq, where he directed the UNESCO mission there and worked as a professor of physics at Baghdad University. Dr. Baez was the father of folk singers Joan Baez and Mimi Fariña. The Los Angeles Times (March 23, 2007) carries an obituary written by Valerie J. Nelson. For details of the Kirkpatrick-Baez-type mirror, see the paper, P. Kirkpatrick and A. Baez, *J. Opt. Soc. Am.* 38, 766 (1948).

NEW PRODUCTS

HORIBA Jobin Yvon's latest X-ray microscope with 10 μm resolution (August 30, 2007)

HORIBA Jobin Yvon has introduced the XGT-7000, the latest system in the XGT series of energy dispersive X-ray fluorescence (EDXRF) microscopes. A choice of two

different X-ray beam sizes is available on the system, ranging from 1.2 mm through to 10 μm . For further information, Phone: +1 -732-494-8660, info@jobinyvon.net, <http://www.jobinyvon.com>

Rigaku introduces two advanced CCD X-ray detectors for crystallography applications (August 22, 2007)

Rigaku Americas Corporation has announced the introduction of two new high-performance CCD-based area X-ray detectors, the Saturn 944+ (94 mm \times 94 mm image area) and Saturn 724+ (72 mm \times 72 mm image area), which deliver high readout speeds without any significant increase in read noise, compared to the previous series. The new detectors employ the advanced KodakR KAF-4320E CCD sensor, incorporating transparent indium tin oxide (ITO) technology for superior sensitivity. They are also equipped with a high-speed 18-bit analog-to-digital converter and 4-port parallel readout to deliver low noise, a true 17,500:1 dynamic range and ultrafast readout times simultaneously. For further information, contact: Joseph D. Ferrara, Phone: +1-281-362-2300, joseph.ferrara@rigaku.com, http://www.rigaku.com/index_en.html

SII's new XRF coating thickness gauge (August 1, 2007)

SII NanoTechnology Inc. has released the SFT9550, a fluorescent X-ray coating thickness gauge for measuring the thickness of metallic films deposited on large printed circuit boards, electronic parts etc, of up to 400(X) \times 300(Y) \times 45(Z) mm in size. The power of the X-ray tube is 50 kV-1 mA and a liquid nitrogen-free type semiconductor detector is employed. The price of the standard product is 14,900,000 JPY. For further information, Phone: +81-6-6280-0066, <http://www.siint.com/en/contact/index.html>

Thermo Fisher Scientific releases integrated XRF/XRD analyzer for the cement industry (July 30, 2007)

Thermo Fisher Scientific Inc., has introduced its new ARL 9900 Series X-ray WorkStation, designed for cement process and quality control. For the first time, full X-ray Diffraction (XRD) and X-ray Fluorescence (XRF) are combined in a single instrument, bringing increased productivity and reduced cost of ownership. For further information, Phone: +1 800-532-4752, analyze@thermofisher.com, <http://www.thermo.com/elemental>

Bruker introduces new X-ray source-detector combination (July 30, 2007)

Bruker AXS Inc., has introduced a new Super Speed X-ray source-detector combination - Incoatec's Microfocus Source, the $1\mu\text{S}$, which is connected to a "Quazar" Montel multilayer optic for 2D beam shaping, and Bruker's VANTEC-2000 detector. For further information: contact Michael Willett, Investor Relations and Public Relations Officer, Phone:

+1 (978) 663-3660, ext. 1411, Michael.Willett@bruker.com, <http://www.bruker-axs.com/>

PANalytical's new version software for X-ray reflectometry (July 20, 2007)

PANalytical has released a new version of its software tool for the analysis of X-ray reflectometry data, X'Pert Reflectivity 1.2, which enables the automatic fitting of simulated to experimental specular X-ray reflectivity curves. The new version increases the level of automation possible. Using a choice of three automatic fitting procedures, the software performs multiple simulations to refine selected sample and instrument parameters, ensuring the best fit with the measured data. For further information, Phone: +31-546-534444, Fax: +31-546-534592, info@panalytical.com, <http://www.panalytical.com/>

CORPORATE

Siemens and Xintek form joint venture to develop field emission type multi-pixel X-ray tubes (September 18, 2007)

Siemens Medical Solutions and Xintek Inc. have announced that they have signed an agreement to establish a joint venture company, named XinRay Systems, in Research Triangle Park, North Carolina, USA. The mission of the new company is to develop a new multi-pixel X-ray source technology for a broad range of diagnostic imaging applications. For the past two years, Siemens and Xintek have cooperated in developing nanotechnology-based field emission X-ray source technology. For further information, cpublicrelationsusa.med@siemens.com (Siemens Medical Solutions), <http://w1.siemens.com/en/entry.html>, or Phone: +1-919-313-9638, info@xintek.com (Xintek), <http://www.xintek.com/>

Oxford Instruments plc acquires VeriCold Technologies GmbH (August 20, 2007)

Oxford Instruments plc has announced the acquisition of VeriCold Technologies GmbH, which manufactures and markets a range of cryogen-free products based on its pulse tube cooler technology. For further information, contact Lynn Shepherd, Corporate Communications Manager, lynn.shepherd@oxinst.co.uk, <http://www.oxinst.com/>

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Kenji Sakurai

News Editor

sakurai@yuhgiri.nims.go.jp
or sakurai@pas.tsukuba.ac.jp