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In Situ FTIR Inspection Is a Convenient New Tool for Analyzing and Viewing Samples

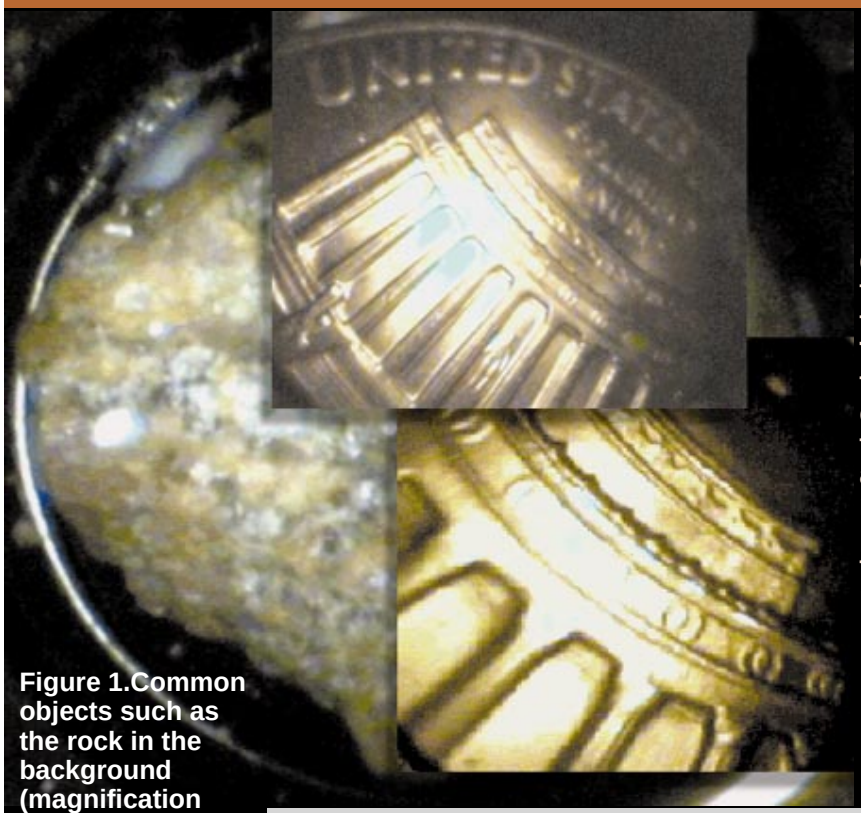

Figure 1.Common objects such as the rock in the background (magnification ~10x) and the penny (magnification 7.5x and 32x) demonstrate the view seen directly through the diffuse reflectance accessory of the infrared spectrometer. The direct-viewing capability enables researchers to perform spectroscopy in the precise area of interest.

"Sample viewing directly through the diffuse reflectance accessory. This is a noteworthy enhancement of the instrumentation, brought about by collaboration of NMT personnel and the industrial partner. "

Fourier Transform Infrared (FTIR) spectroscopy is widely used in industry to analyze organic compounds and to determine the chemical structure of many inorganic ones. Applications include material identification and evaluation, quality control screening, and characterization of surface residues. In a glove box environment where air-sensitive materials or nuclear materials are handled, the difficulty of making analytical measurements compared to making them in a routine laboratory environment increases dramatically.

FTIR spectroscopy has been used in the glove box environment in NMT Division for many years, notably in the Molecular Laser Isotope Separation Program, where in-line gas cells were used to monitor the process. However, varied sample matrices to be analyzed, including parts as well as samples from various processes, usually have to be transferred to the glove box where the spectrometer is situated.

continued on page 2

In Situ FTIR Inspection Is a Convenient New Tool for Analyzing and Viewing Samples *(continued)*

This article was contributed by **Joe Baiardo** (NMT-11). Others who work on the project include **John Ward** (Laboratory Fellow, Ret., NMT-11) and **Trish Wright** (NMT-15). **Stephanie Hale** (formerly NMT-5) obtained capital equipment funds for development of the prototype instrumentation. Other support for this project was provided by **Doug Kautz** (NMT-5) and **Patrice Stevens** (NMT-15). The glove-box-adapted system including the visualization accessory has also been implemented by Y-12.

Recently, the availability of portable FTIR spectrometers allows in situ examination of samples in a glove box environment. This article describes a simple, portable FTIR inspection system that allows sharing of instrumentation and accessories among several glove boxes. Sharing is accomplished by mounting the FTIR on a standard service panel on top of each glove box where FTIR measurements are performed. Thus, the system can be moved to any glove box that has been fitted with the appropriate service panel. The prototype instrumentation and accessories described here include a remote inspection accessory with interchangeable sampling heads, including diffuse reflectance (DR) and specular reflectance, and a novel visualization accessory that allows in situ viewing of the sample with variable magnification (Figure 1). This system is now commercially available.

The heart of the system is the patented, portable FTIR spectrometer manufactured by Surface Optics Corporation (SOC). The system was designed to be able to record infrared (IR) spectra in field situations. For example, G. L. Powell (co-developer with SOC at Martin Marietta Energy Systems, Y-12, Oak Ridge) has used the system to record spectra of aging paints on airplane wings for NASA. This spectrometer incorporates a source, interferometer, and DR sampling optics with a built-in detector in a package that weighs about 20 pounds and occupies about 0.8 cu. ft.

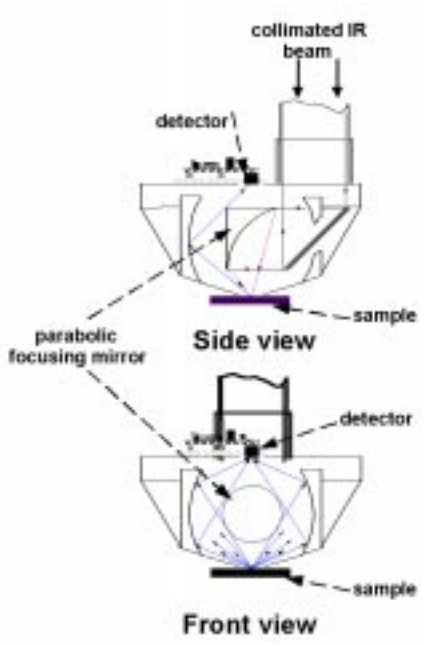

Figure 2. Anatomy of the barrel ellipse diffuse reflectance head. The instrument can be used for verification of a cleaning process or for the identification of undesirable organic residues or molecular species adsorbed on the surface of metal oxide powders.

This FITR sampling method makes use of the most efficient DR collection system available today, known as the patented "barrel-ellipse head" (Harrick Scientific and SOC), shown schematically in Figure 2.

Diffuse reflectance may be used to examine most surfaces that are able to scatter light. Characterization of organic films on machined metal surfaces is thus easily achieved with this technique so it can be used to certify cleaning processes, for example. Another important application among many is the ability of the DR technique to measure the IR spectra of molecules adsorbed on metal oxide powders. These are two applications of interest in NMT Division, and they are highlighted in this article.

Several instrument modifications were necessary for their use in NMT Division. The most important changes were to redesign the barrel-ellipse so it could be operated as a replaceable head on the end of a gold-coated light pipe and to incorporate a novel sample-viewing system that allows, with the flip of a switch, concurrent video imaging of the sample surface to be examined by the IR beam. While sample-viewing attachments are available with other sampling optics in IR spectrometers today, no other systems are able to view directly through the DR accessories. This is a noteworthy enhancement of the instrumentation, brought about by collaboration of NMT personnel and the industrial partner. The viewing accessory is crucial in determining the correct location on a part of the sample that is to be examined by FTIR. Its value can readily be appreciated if one considers the problem of spectroscopic examination of the interior of a storage can—inside the glove box—using an invisible beam.

Figure 3 shows what is seen on the viewing accessory monitor when the bottom of a stainless steel dressing jar is a few millimeters below the focal plane of the barrel ellipse. The figure in the corner of the image shows spectra

of a smudge on the can surface taken 2 mm apart. By further rotating and translating the can one beam width at a time, one obtains hundreds or thousands of similar spectra correlated with the examined position on the can surface. The surface of the can is then plotted as a grid, and the peak heights of the chromophore that we wish to map (the CH stretch at 2900 cm^{-1}, for example) are scaled to a color and plotted at each position on the grid. In this way one obtains maps of the location of various films and their thicknesses on the can interior. This method can be used for verification of a cleaning process or to identify undesirable organic residues left behind after a process. In the case shown here, one can see that the smudge is more complex than a simple oil (the region—1800–600 cm^{-1}—would consist of only 2 peaks). Actually, the smudge is an intentionally smeared fingerprint.

Another application of interest to NMT Division is the identification of the molecular species (such as impurities) adsorbed on the surface of metal oxide powders. Diffuse reflectance is a convenient and sensitive sampling technique for such powders. There are several reasons for this: first, clean metal oxides do not absorb IR light above 1000 cm^{-1}; therefore, any molecular fragments adsorbed on the oxide surface that absorb IR light will be seen. Second, the high surface area of these powders provides a large number of sites for adsorbates. Third, the extensive scattering of the IR light in the powder leads to a very long effective path for absorption by the adsorbed molecular fragments. For example, when a clean metal oxide surface is exposed to atmospheric water, the water molecules dissociate on the surface to form hydroxyl groups (-OH). As water continues to adsorb and dissociate, more sites become occupied by -OH; with continued exposure to water from the gas phase, water molecules will eventually adsorb on the surface as molecular water. Figure 4 shows the DR/IR spectrum of lanthanum sesquioxide (La_2O_3, lanthana) powder that has been aged in air. Both OH (sharp, 3600 cm^{-1}) and molecular H_2O (broad, 3200–3500 cm^{-1}) spectral features can be seen in the top panel.

Other gases may also react on the oxide surface. Carbon dioxide is readily adsorbed from air and forms various types of carbonates on the oxide lattice. The carbonate region is shown in the lower panel of Figure 4. In fact, for lanthana, samaria, and other rare earth oxides aged in air, it is known that the oxide lattice is partially transformed into hydroxycarbonate-like phases $La_2(OH)_{2(3-x)}(CO_3)_x$, where x is ~1. The strong absorptions seen in Figure 4 are due to these hydroxycarbonate phases within the oxide lattice. The weaker peaks above 3600 cm^{-1} are due to hydroxyl groups on different sites of the oxide lattice. The upper trace is for the sample prior to mild heating (~300˚C), while the lower trace was obtained after heating in air for almost an hour. Temperature-programmed desorption described in the literature shows water desorbing from lanthana at 300˚C and at 450˚C. Our simple demonstration is consistent with this.

These are only two examples of the type of analyses that will be carried out on analogous actinide materials in-line using our portable FTIR instrumentation. The system will be installed this quarter in one of the Bldg. PF4 laboratories.

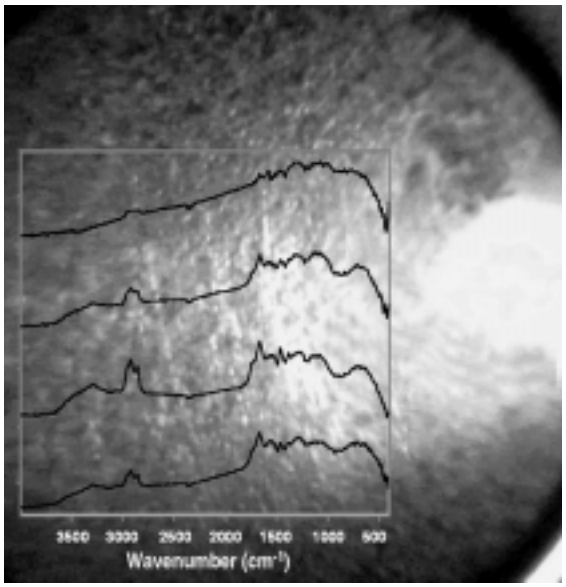

Figure 3. Scene from the viewing accessory monitor when the bottom of a stainless steel dressing jar is a few millimeters below the focal plane of the barrel ellipse. The figure in the corner of the image shows spectra of a smudge on the can surface taken 2 mm apart.

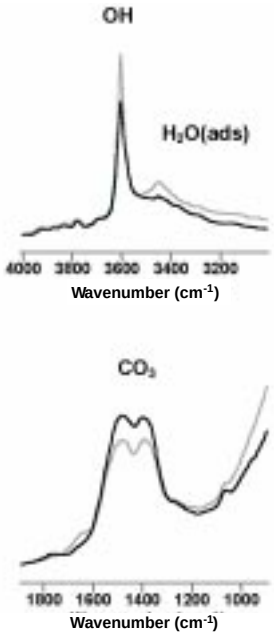

Figure 4. Lanthanum oxide powder before and after mild heating. Even a mild heat treatment causes changes in the amount of adsorbed molecular fragments as shown by the changes in the IR spectra. This same technique will be used with PuO_2 powders to determine the changes in composition and desorption of the molecular adsorbates as a function of temperature.

Neutron Diffraction Gives Pu Melting-Point Information

This article was contributed by **A. C. Lawson** (MST-8). Other researchers on the project include **B. Martinez** (NMT-11), **R. Martinez** (NMT-11), **F. Vigil** (NMT-5), **R. Sheldon** (NMT-9), J. A. Roberts (LANSCE-12), **B. I. Bennett** (NW-SS), and **J. W. Richardson, Jr.** (IPNS, Argonne National Laboratory).

The melting point of plutonium is unusually low, given its position in the periodic system. A criterion for the melting points of materials, devised by F. A. Lindemann in 1910, relates the melting point of a material to its vibrational amplitude at the melting point. In this article, we explain how Lindemann's rule can be used with neutron diffraction data on the light actinides to understand *why* the melting point of plutonium is so low. We find that the *temperature dependence* of the elastic properties of plutonium must be taken into account in order to give a good description of its high-temperature behavior.

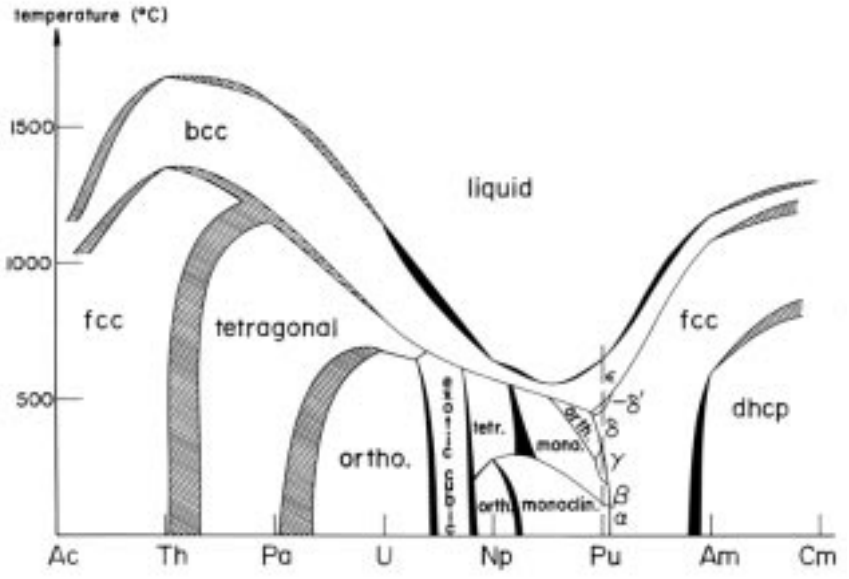

Figure 1. Composite phase diagram for the light actinides. (Used with permission, J. L. Smith and E. A. Kmetko, "Magnetism and bonding: a nearly periodic table of transition elements," *J. Less-Common Metals* 90 83-88, Elsevier Science, Oxford, UK, 1983.)

Figure 1 is a composite phase diagram of the light actinides. It shows that the unusually low melting point that is characteristic of plutonium appears at exactly the same place in the 5-f series where one finds the complex structures for which the actinides are famous. Understanding the anomalous melting point of plutonium is important for modeling its behavior in applications.

No comprehensive theory for the melting points of materials has ever been proposed. Lindemann was inspired by the recent publication of Einstein's theory on the heat capacity of materials. He wanted to devise a way of estimating the characteristic Einstein temperature, an atomistic measure of lattice stiffness on which the predictions of Einstein's theory are based. Lindemann realized that the amplitudes of the thermal atomic vibrations, which also depend on the Einstein temperature, could not become too large before the material would shake itself apart. The mean-square amplitude of thermal vibration is directly proportional to the absolute temperature and inversely proportional to the square of the Einstein temperature, so Lindemann could use Einstein's theory to estimate the temperature at which the atoms would begin to experience violent collisions with their neighbors. Thus, he was able to devise a simple formula that related the Einstein temperature to the melting temperature. His paper was published just before the invention of the Debye theory in 1914, which is still the basis of the modern theory of heat capacities and atomic vibrations.

The Debye temperature (roughly equivalent to the Einstein temperature) for plutonium is 132 K. Using the Lindemann equation, the melting temperature for Pu is 1700 K—which is too high by a factor of two! Does this discrepancy mean that something is wrong with the Lindemann criterion? No, the problem is that Debye temperature decreases quite

strongly with temperature, and it is so large that the Debye temperature is reduced to only 89 K at the melting point. When this lower value of the Debye temperature is used, a value of 779 K is obtained for the melting point, in much better agreement with the experiment. The discrepancy is reduced from 88% to 15%. We conclude that temperature-induced softening of the lattice is responsible for the low melting point of plutonium.

We have used neutron powder diffraction at LANSCE and at the Intense Pulsed Neutron Source at Argonne National Laboratory to measure the temperature dependence of the Debye temperature for all the light actinides. We have data for Th, α-U, α-Np, α-Pu, and δ-Pu alloys. Single crystals are not required for these measurements.

Polycrystalline Np and Pu samples were prepared in NMT Division from pure electrorefined metal. The neptunium metal was 99.97 wt % neptunium; the highest impurity levels were from calcium and are typically 100 ppm. All other impurity levels were less than 100 ppm. The plutonium metal was 99.85 wt % plutonium with isotopic enrichment to 95% ^{242}Pu. This isotope is required to minimize the absorption of neutrons. Alloys were prepared by arc melting. Rods were cast either in a casting furnace or the hearth of the arc melter and turned to the final dimensions. All samples were heated to 450°C. The samples were doubly encapsulated in thin-walled vanadium tubes for radiological containment during the neutron diffraction experiments.

Figure 2 shows the melting points for the light actinides together with two estimates of the melting point based on the Lindemann rule. The ●s show the measured melting points. The ▲s shows the Lindemann estimate of the melting point based on the low-temperature value of the Debye temperature uncorrected for its temperature dependence. The ■s show the Lindemann estimate with the Debye temperature corrected for its temperature dependence measured with neutron scattering. The corrected data provide a good estimate of the melting point.

For many materials, some temperature dependence of the elastic properties is induced by thermal expansion. This is because the atoms are subjected to weaker forces when they move further apart as the temperature is raised. However, the thermal expansion of δ-phase plutonium is negligible, so the observed lattice softening is an intrinsic effect, arising from the electronic structure or other f-electron physics. Our work shows that these effects must be taken into account in order to predict the behavior of plutonium at high temperatures.

The anomalous temperature dependence of the elastic properties of plutonium can be studied at a more fundamental level by looking at inelastic neutron scattering. Such experiments are planned at LANSCE on both polycrystalline and single-crystal specimens of plutonium.

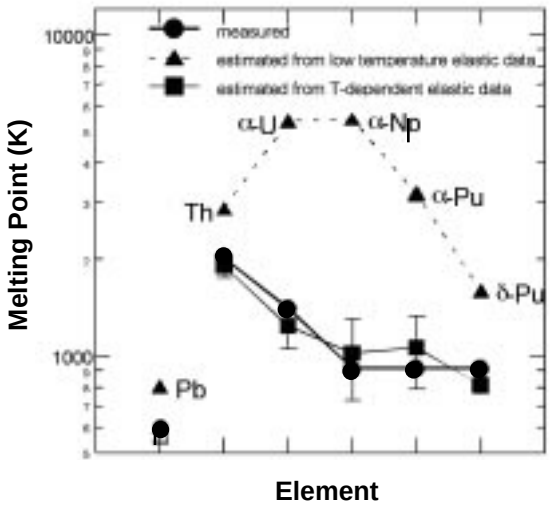

Figure 2. Calculated and observed melting points for the light actinides and for lead. Neutron diffraction showed that the temperature dependence of the elastic properties of plutonium must be taken into account in order to give a good description of its high-temperature behavior.

NMT Launches a Science Leadership Council (SLC)

This article was contributed by **Kyu C. Kim**, NMT chief scientist.

The past few years have seen a tremendous growth of the Nuclear Materials Technology (NMT) Division in terms of programs and the operation of nuclear facilities. NMT Division now operates two major nuclear facilities, the Plutonium Facility at Technical Area 55 and the Chemistry and Materials Research Building at Technical Area 3. The combined two facilities employ some 700 regular University of California employees and more than 300 contract employees. In addition, NMT supports about 70 students, including postdoctoral research fellows, throughout the year. Some 290 technical staff members and 274 technicians are involved in scores of scientific and technical programs.

The breadth and depth of the scientific and technical projects and their execution within the framework of the operation of nuclear facilities operation require a strong scientific and technical leadership as well as quality management of our resources and capabilities. This can be accomplished only through the active participation of all our members, from the planning stage to the execution of individual projects. The Science Leadership council (SLC) is born with this collective leadership and participatory management in mind.

In September seven distinguished NMT scientists joined the rank of NMT's newly established SLC. Nominated by their peers and chosen by a selection committee composed of internal and external reviewers, the council members are appointed by the NMT Division Director based on recommendations from the selection committee. The newly appointed members will serve the first three-year term (see Figure 2). Additional members will be appointed; qualified individuals are nominated every year to lead staggered terms. The SLC will consist of no more than ten NMT researchers at any one time.

The SLC is composed of nonmanagerial scientific leaders of the division, and its members are selected based on criteria that include a record of significant scientific and technical achievement, peer recognition, publications, external reputation and visibility, and membership in and contributions to professional societies, including leadership positions in those societies. NMT SLC members will function for the division in a manner analogous to that in which the Laboratory Fellows function for the Laboratory, providing scientific leadership division-wide. Therefore, SLC members are the division equivalents of select "senior scientists."

The SLC does not replace the present leadership residing in the technical groups and the division. Its purpose is to augment NMT's *scientific* leadership by advising division management on important issues affecting NMT Division's science and technology operations, programs, and plans. The council will provide a mechanism for the division's scientists and

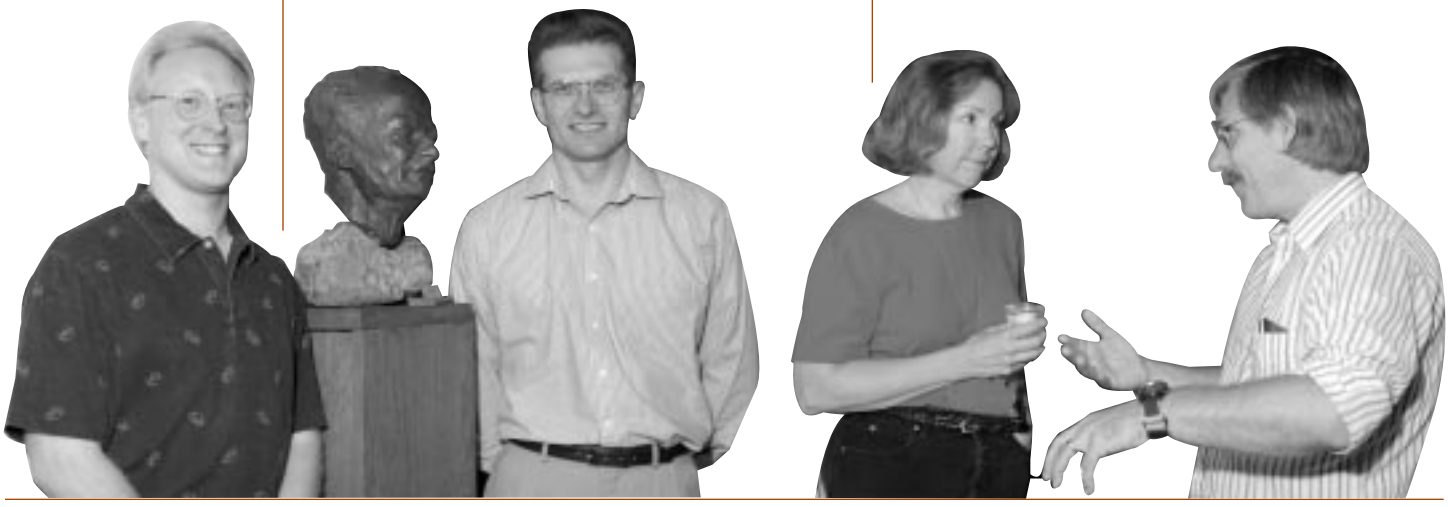

Figure 1. SLC members David Clark (ex officio) and George Havrilla pose by a bust of Hans Bethe; Barbara Martinez and Kirk Veirs converse during a break in the inaugural meeting.

Figure 2. Members of the newly established Science Leadership Council (SLC) are (left to right) Kirk Veirs, George Havrilla, Gordon Jarvinen, Sam Pillay, Barbara Martinez, Tom Zocco, and Wayne Smith. During the council's initial year, Division Chief Scientist K. C. Kim and the Director of the Los Alamos branch of the Seaborg Institute, David Clark, will be ex officio members of the council.

engineers to influence the scientific and technical directions of NMT Division. In addition, it is hoped that the establishment of the council will provide a path for advancement based upon technical accomplishment, with accompanying salary and prestige. The SLC will operate on the highest and most prestigious level and will report directly to the division management.

The SLC is charged with the following responsibilities:

(1) Drafting the division's strategic plan for science and technology;
(2) Enhancing the effectiveness of NMT's division-wide efforts in science and technology;
(3) Advising division management on future directions of research in NMT Division;
(4) Coordinating the recruitment and evaluation of postdoctoral applications;
(5) Enhancing the visibility of NMT science and technology externally and internally;
(6) Promoting NMT scientists for fellowships and memberships in professional societies, external awards and honors, and NMT and LANL awards including Laboratory fellowships; and
(7) Running a divisional seminar program.

In carrying out its charge, the SLC will meet regularly to define and address key issues regarding the effectiveness of science, technology, and research in NMT Division. The council also will be responsible for the division's award program and for the division's nominations for external and Laboratory-wide awards.

The establishment of the SLC is one of a number of new steps NMT has taken toward enhancing its science and technology base in recent months. We hope that the launching of the SLC at this critical time will help the division enhance the visibility of its science and technology, promote an excellent workforce, and strive for excellence in everything we do.

Figure 3. NMT consultant Gerd Rosenblatt and ex officio member K. C. Kim during the committee's meeting.

NMT Charters New Group for Pits

The new NMT-15 Group Leader **Tim Nelson** contributed this article.

The Pit Disassembly and Surveillance Technologies Group, NMT-15, has been chartered to lead the United States with technological support of new and ongoing pit disassembly and surveillance campaigns. Several technological support areas comprise this group, which includes the following major research projects:

(1) Advanced Recovery and Integrated Extraction System (ARIES),
(2) Pit Disassembly and Conversion Facility (PDCF),
(3) US-Russian collaborations to reduce the global nuclear danger,
(4) Pit Surveillance, Surveillance Information Systems (SIS), and enhanced surveillance,
(5) Special Recovery Line (SRL), and
(6) Electrolytic decontamination technologies.

These projects are described briefly below.

Advanced Recovery and Integrated Extraction System (ARIES)

The ARIES Demonstration Project consists of six modules—Pit Bisector, Hydride-Dehydride-Recycle, Direct Metal Oxidation, Canning, Electrolytic Decontamination and Packaging, and Nondestructive Assay—with a remotely controlled conveyor system to move material between the modules.

After receiving approval from LANL's Plutonium Facility management, the Department of Energy, and several independent readiness review committees, the ARIES Team conducted "hot" start-up activities between November 1998 and July 1999. Some procedural and equipment modifications were subsequently made. The initial ARIES "production" demonstration to process pits within three months began in July 1999. By mid-August, the demonstration was 50% complete; it included processing at least one of each of the proposed seven surplus pit types.

Research under the ARIES project includes electrochemistry, new and improved engineering techniques, plutonium interactions with other elements, materials science engineering, process controls, various nondestructive assay measurements, dose collection, and robotics. All of the research development and demonstrations support the DOE Office of Fissile Materials Disposition program for surplus plutonium disposition.

Pit Disassembly and Conversion Facility (PDCF)

Interactions between Los Alamos National Laboratory, Westinghouse-Savannah River (the preferred alternative site pending the Record of Decision for the PDCF), and Raytheon (the design firm) are underway to transfer ARIES technology in support of the full-scale production plant. Working closely with Westinghouse personnel should assure a strong, site-specific scope of work, well-defined roles and responsibilities, development of a technically feasible facility demon-

Figure 1. ARIES hydride/dehydride furnace during cold testing.

stration document, as well as workable Title I (cost estimate) and Title II (detailed cost estimate) designs. While funding is available for the design, Congressional language states that funds for the construction of the PDCF are contingent upon Russia's progress on the disposition of her nuclear weapons. Success of the US program, therefore, is dependent on success of the Russian program. Research activities include new and improved design/engineering techniques for the disassembly and conversion of all types of nuclear weapons.

US-Russian Collaborations

US collaborations with the Russian Federation continue with cooperative research and development of technologies to convert weapons-origin plutonium to a suitable form of mixed oxide (MOX) fuel for light-water reactors. Since the nondestructive assay system is the same for the US and Russia, it is an integral component of pit conversion and could be used to support independent verification through bilateral or international agreements on the dismantlement of nuclear weapons. The current economic situation in Russia threatens to retard or halt progress without international support; thus, the US is funding significant disposition efforts in Russia.

Los Alamos is the lead national laboratory for Russian collaborations on technologies to disassemble nuclear weapons and convert the extracted plutonium into MOX fuel or other unclassified forms suitable for international inspection. In order to understand the Russian process for developing facilities, NMT-15 is conducting a series of workshops on design, licensing, constructing, and commissioning of nuclear facilities. The product of this effort is a flow sheet showing the logic of the Russian process compared to that of the US. These workshops will also generate a generic schedule to serve as the starting point for preparing a more specific schedule for the Russian PDCF. The end of 1999 is the target for the completed current efforts and a preliminary feasibility study, followed by selection of a conversion process.

Figure 2. Senator Pete Domenici (second from left) tours the ARIES NDA system.

Pit Surveillance Program (PSP) and Stockpile Information Services (SIS)

The PSP supports the surveillance of pits (evaluation and shelf life) as well as the SIS. The PSP is responsible for monitoring, detecting, and addressing potential problems within weapon systems. The SIS project is responsible for providing PSP pit engineers, material scientists, and customers throughout the DOE/DP complex with information on nuclear weapon pit production, the stockpile, and experimental records. Weighing, photography, gas sampling, leak checking, radiography, eddy current testing (nondestructive tests using electrical current to help determine if there are gaps between materials), ultrasonic testing (nondestructive tests using sound waves to determine if there are gaps between materials), and acoustic resonance spectroscopy are some analyses performed on pits selected for destructive evaluation or disassembly. Some pits are held in the shelf-life program. These pits are used for trend analysis of gas data. Some nondestructive testing will be performed on war reserve or "rebuild" units once their production begins at TA-55. Metallography,

NMT Charters New Group for Pits *(continued)*

chemistry, hydriding-dehydriding of residues, and surface analyses are performed in a timely manner as part of the evaluation process. The final analyses result in the generation and publication of pit evaluation reports for completed disassemblies, as well as those in the "rebuild" program. Some shelf-life units are also disassembled for evaluation.

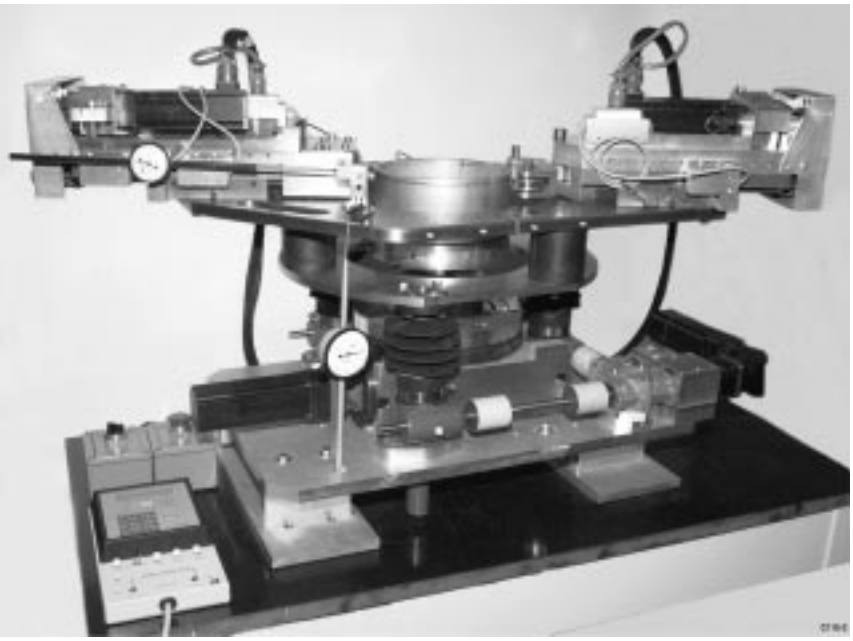

Figure 3. Pit bisector used to cut pits in half. This instrument was developed in collaboration with Lawrence Livermore National Laboratory.

Special Recovery Line (SRL)

The SRL is chartered with decontaminating tritium from plutonium. This process line represents a one-of-a-kind capability within the DOE complex. Research activities include new and improved engineering techniques, characterization of tritium-plutonium interactions, and other materials science engineering.

Electrolytic Decontamination for Glove Boxes and Packaging Highly Enriched Uranium

Electrolytic Decontamination (EDC) is the process for removing radioactive contamination from surfaces. The EDC process used here represents the only operating system in the US for packaging plutonium metal or plutonium oxide to meet the DOE-STD-3013-96 packaging criteria. Research in the packaging activity includes electrochemistry, engineering development of packages, welding, process controls, fluid handling, and robotics.

The baseline technology within the DOE complex for removing plutonium contamination from the surface of highly enriched uranium is EDC, which leads to the disposition of the material at Y-12. Research activities include alpha-spectroscopy techniques, electrochemistry, and engineering.

Decontaminating transuranic-waste-level items to low-level waste items leads to great cost savings and reduces potential radioactive contamination exposures. In situ glove box decontamination using EDC methods is resulting in low levels of contamination. Research activities include electrochemistry and engineering.

Publications and Invited Talks (June 1999–August 1999)

Editor's note: It may be many months between the time papers are assigned LA numbers (that's when we become aware of them) and when they are published. ARQ lists only those papers that are published or have been accepted for publication and must rely on authors to tell us when these criteria are met. So when your paper is accepted or published, we'll tell your colleagues. Please let us know! Ann Mauzy <mauzy@lanl.gov>.

Journals

Hang W., X. M. Yan, D. M. Wayne, J. A. Olivares, W. W. Harrison, and V. Majidi, "Glow discharge source interfacing to mass analyzers: Theoretical and practical considerations," *Analytical Chemistry* **71**(#15), pp. 3231-3237 (August 1999).

Havrilla, G. J., and J. R. Schoonover, "Mesoscale Chemical Imaging for Advanced Materials Analysis," *Materials World* (in press, October 1999).

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Jarvinen, G. D., and J. A. Thompson, "Polymer Filtration Using Water-Soluble Polymers and Ultrafiltration to Remove Dissolved Metal Ions, *Filtration & Separation Magazine* **36**, pp. 28–32 (June 1999).

Park, J. J., J. J. Buksa, M. G. Houts, and E. D. Arthur, "Estimates of the Service Lifetime of 304 Stainless Steel for Use in the Blanket Region of the Los Alamos National Laboratory Accelerator Based Conversion of Plutonium System," *Nuclear Engineering and Design* (in press).

Schoonover, J. R., G. J. Havrilla, and P. J. Treado, "Vibrational Microscopy and Imaging of Heterogeneous Inorganic Materials," *Vibrational Spectroscopy* **3** (3) (June 1999).

Proceedings

Global '99, International Conference on Future Nuclear Systems, American Nuclear Society, Inc., LaGrange Park, IL (June 1999). Bonchin, S. L., and D. J. Gerth, "Investigation of a Microconcentric Nebulizer for Plutonium Analysis by Inductively Coupled Plasma Atomic Emission Spectrometry"; Figg, D. J., and L. R. Drake, "Laser Ablation Inductively Coupled Plasma Mass Spectrometry for Plutonium Analysis"; Figg, D. J., and A. A. Martinez, "Inductively Coupled Plasma—Mass Spectrometry of Plutonium Samples"; Shepard, B. A., S. L. Bonchin, and D. J. Figg, "Analysis of Boron and Silicon in Plutonium Samples by Inductively Coupled Plasma Spectrometry; Schoonover, J. R., G. J. Havrilla, and P. J. Treado, "Chemical Imaging Applications of Materials Characterization: Corrosion, Alloys and MOX Feed Surrogate"; Smith, C.A., and M. A. Martinez, "Gallium Content in PuO_2 Using Laser Induced Breakdown Spectroscopy (LIBS)"; and Wayne, D. M., D. K. McDaniel, and C. Lewis, "Modular Steady-State Glow Discharge Quadrupole Mass Spectrometer System for the At-Line Analysis of Plutonium Metal."

Other Publications

Bonchin, S. L., G. K. Zoorob, and J. A. Caruso, "Atomic Emission, Methods and Instrumentation," in *Encyclopedia of Spectroscopy and Spectrometry*, J. C. Lindon, G. E. Tranter, and J. L. Holmes, Eds., Academic Press, Ltd., London, England (in press, September 1999).

Newsmakers

■ **NMT Announces 1999 S&T Awards**

The following division members have won the 1999 NMT Science and Technology Achievement Awards: **Mary E. Barr, John M. Berg, *David L. Clark, John D. Farr, George J. Havrilla, Heather T. Hawkins, *Gordon D. Jarvinen, Jane A. Lloyd, Dennis D. Padilla, Roland K. Schulze, Dane R. Spearing, Jeffrey H. Terry, Jr., *D. Kirk Veirs, David M. Wayne, Laura A. Worl, *Jennifer S. Young,** and **Thomas G. Zocco**.

This award is based on their publications in refereed journals, conference presentations, and LA reports from July 1, 1998, through June 30, 1999. The list also includes the authors and co-authors of the five best poster papers in the May Division Review. ***Those with an asterisk have won both the most-published authors awards and the best Division Review poster awards.**

■ **Division Director Steps Down**

Division Director **Bruce Matthews** is transferring to the Science and Technology Based (STB) Program Office until December, when he will take a position in the Senior Scientific Manager Return to Research Program at one of the University of California campuses. *Actinide Research Quarterly* wishes him well in his goal to develop an integrated, multicampus set of research proposals in support of Lab programs in stockpile stewardship, threat reduction, environmental stewardship, and supporting science missions.

■ Second in a series, the Plutonium Futures—The Science conference will be held July 10–13, 2000, in Santa Fe, New Mexico. An international conference, it will consist of a student tutorial, a plenary session, and technical presentations covering all aspects of actinide science. Additionally, it will provide a forum for illustrating and enhancing capabilities, interests, and issues in these areas. Scientists, engineers, and students from universities, national laboratories, DOE's nuclear complex, and throughout the world are encouraged to participate and make technical contributions. For further information, to view the call for papers, or to submit a paper, please visit the conference Web site at http://www.lanl.gov/pu2000.html.

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