Scientific Basis for Nuclear Waste Management Symposium Addressed Geological Disposal of Radioactive Waste

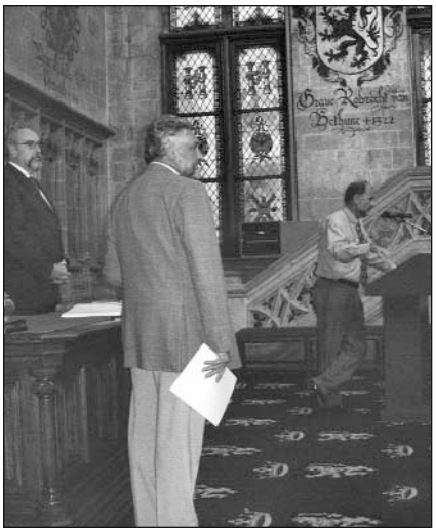
The 29th International Symposium on the Scientific Basis for Nuclear Waste Management was held in Ghent, Belgium, September 12–16, 2005. The conference was co-sponsored by the FWO (the Research Foundation–Flanders), endorsed by the Materials Research Society, and held in cooperation with the Nuclear Energy Agency (NEA–OECD) and the International Atomic Energy Agency (IAEA). Pierre Van Iseghem of SCK–CEN in Belgium chaired the organizing committee.

The symposium offered an overview of the international status of research on the geological disposal of radioactive waste. Symposium topics covered waste forms, container materials, analogs, radionuclide behavior, integrated testing, and safety case. With an attendance of 190, the symposium consisted of 58 presentations and 89 posters. Keynote lectures provided critical assessments of the state of the art in the major topics. Proceedings are scheduled for publication as an MRS symposium proceedings volume in September 2006.

Introductory presentations highlighted the status of some major underground disposal programs worldwide. J. Vira of POSIVA discussed the different steps that Finland is taking before the planned submission of a license application for the construction of an underground repository at the Olkiluoto site in 2012. H. Umeki of JNC presented the generic R&D program ongoing in Japan in two sites: Mizunami in crystalline rock, and Horonobe in sedimentary rock. J. Bel of NIRAS/ONDRAF presented the supercontainer disposal concept recently proposed in Belgium.

P. Van Iseghem (SCK–CEN) and C. Poinssot (CEA), in their keynote presentations, discussed the consensus that the long-term dissolution rates of glass and spent fuel are considerably lower than the initial dissolution rates. The lifetimes of these waste forms in repository water are expected to be 10^5–10^7 years. L. Johnson (NAGRA) discussed the elaboration of the Safety Case of the whole repository system, including engineered barriers and host rock, stating that it may become clear that the contribution of the engineered barriers to the retardation of the radionuclide transfer to the biosphere becomes negligible (e.g., glass disposed in a clay rock). B. Grambow (SUBATECH) reported on the coupling of the chemical processes in the near-field, and concluded that the engineered barriers (e.g., bentonite backfills, glass waste forms) can retard radionuclide release in a similar way as the host rock. A ~50-cm-thick bentonite backfill around the high-level waste package will by itself result in an annual fraction of radionuclides released of 10^{-12} or lower.

Participants visit and discuss research during one of the poster sessions at the 29th International Symposium on the Scientific Basis for Nuclear Waste Management, held in September in Ghent, Belgium.



Alderman Mr. Decaluwe (center) and symposium chair Pierre Van Iseghem of SCK–CEN (right) during the reception in the City Hall of Ghent.

The technical sessions of the symposium spanned four days and were complemented with events held in the medieval center of Ghent: a reception in the City Hall, hosted by the Alderman, Mr. Decaluwe; a dinner in the Castle of the Counts; and a guided tour through Ghent that highlighted the historical role of one of its most famous habitants from the 16th century: Emperor Charles Quint. Technical visits on the fifth day took participants to the Forschungszentrum Jülich in Germany; the HADES underground research laboratory in the Boom clay at the nuclear research center in Mol; and the Belgian conditioning facility Belgoprocess.

PIERRE PH. VAN ISEGHEM
SCK–CEN
Symposium Chair

SMMIB05 Emphasized Nano- and Biotechnologies, Industrial Applications, and Emerging Research Topics

The 14th International Conference on Surface Modification of Materials by Ion Beams (SMMIB05) was held in Kusadasi, Turkey, September 4–9, 2005. Ahmet Öztarhan of Ege University, Izmir, served as the conference chair as well as host and organizer of the meeting.

The conference attracted more than 180 attendees from over 34 countries, with the highest attendances coming from Japan, Turkey, the United States, Russia, Korea, China, Thailand, Germany, Spain, and South Africa. There were more than 50 student attendees, over a dozen major industrial exhibitors (most of whom are involved in commercial applications of ion-beam techniques), and more than two dozen industrial participants.

The conference topics represented a range of emerging technologies in which treatment by energetic ion beams or plasmas opens a world of options for tailoring specific critical properties of surfaces, thin films, or membranes at the nano- or microscale, at an industrially viable scale. New advances in successful applications and new insights into the underlying beam interactions were reported and discussed, ranging from the classic implant-hardening of tool steels to emerging applications for nanoscale lithography, engineered biocompatible or bio-activated surfaces, polymer processing, and nanoparticle manipulation. The vitality of this program served to underscore a renewed global investment in ion-beam techniques that are seen to offer unique capabilities in fast-evolving nano- and biotechnologies.

Symposium topics included materials processing and properties; industrial applications; techniques and equipment development; modeling, simulation, and theory; ion beams in nanotechnology; and biological applications of ion-beam techniques.

The conference opened with an elegant reception in the forecourt of the historic Celsius Library of the ancient city of Ephesus. The program of invited talks, oral presentations, and posters began the next day with a brief retrospective of the IBMM Conference series since its inception in 1979, presented by Geoff Dearnaley (AERE Harwell and the Southwest Research Institute), a founder of the conference.

Insert \a I. Yamada (University of Hyogo, Kamigori) described nanoscale surface modification using gas cluster ion beams. Yamada noted that cluster source technology has matured, enabling new technical applications such as nanometer-scale smoothing of surfaces, noncontact chemical–mechanical polishing, microlens arrays, pore sealing, and surface densification of low-κ dielectrics.

Ahmet Öztarhan, chair of the conference (left), discusses schedules with his wife and John Baglin, a member of the Program Committee and co-editor of the proceedings.

M. Aziz (Harvard) described a breakthrough in understanding ion-induced formation of surface ripples by a nonlinear edge growth theory, leading to new applications, for example, in growing nanopores. W. Ensinger (Darmstadt University of Technology) described the growth of nanopore membranes from polymer foils. P.K. Chu (City University of Hong Kong) described plasma-enhanced biocompatibility of surfaces of metals, ceramics, and silicon, with many clinical applications. J. Ishikawa (Kyoto University) described ion implantation for manipulation of cell growth and repair of the nervous system. W. Bruenger (Fraunhofer Institute, Itzehoe) and J. Baglin (IBM) discussed ion projection tools enabling full-wafer patterning with feature sizes of a few nanometers, either for direct surface patterning or as an alternative for traditional lithography.

A. Yializis (Sigma Technologies International) described commercial adoption of customized plasma tools capable of high-speed web processing of polymer surfaces. R. Wei (Southwest Research Institute) and A. Alpas (University of Windsor) each discussed promising tribological applications for ion-beam engineered tribological coatings for advanced tools for the automotive industry—a

(Left to right) Daryush Ila (International Scientific Committee), I. Yamada (exhibitor), M. Aziz (Harvard), and Kji Kasuga (Hakuto Co.), during a coffee break in the Exhibit Hall.

topic of particular relevance for the host country of Turkey.

More than 50 students participated in the SMMIB05 conference; three were presented with gold-level prizes (1st Prize: Noriyoshi Takahashi of Tokyo University of Science, Japan; 2nd Prize: Anjum Qureshi of M.S. University of Baroda, India; and 3rd Prize: Alexey N. Mikhaylov of the Physico-Technical Research Institute, Russia), and seven students were presented with silver-level prizes (İstem Özen of Sabanci University, Turkey; Lütfi Öksüz of Dublin City University, Ireland; Volha Abidzina of Belarusian–Russian University, Belarus; Sema Sen of ODTU University, Turkey; Supunne Promthep of Chiangmai University, Thailand; Demiral Akbar of ODTU University, Turkey; and Frank Rotter of the University of Göttingen, Germany) during the conference banquet. The graduate student program was managed by A. Öztarhan and D. Ila, and the judging panel members were W. Ensinger (University of Marburg, Germany), A. de Almaida (Universidade de São Paulo Ribeirão Preto, Brazil), G. Hubler (Naval Research Laboratory, USA), and Yoshio Okabe (Saitama Institute of Technology, Japan).

(Left to right) Graham Hubler (Naval Research Laboratory, USA), Wolfgang Ensinger (University of Marburg, Germany), Yoshio Okabe (Saitama Institute of Technology, Japan), and A. de Almaida (Universidade de São Paulo Ribeirão Preto, Brazil) were members of the Graduate Student Award Committee.

The topics presented resonated with both the academic and industrial communities in the Izmir region. The conference received substantial financial support from corporations and was the subject of a 30-minute discussion broadcast by Turkish National Television. Such timely technical interest, coupled with the efficiency and warmth of the host community in Kusadasi, left no doubt that Turkey had been an outstanding national host for this international event.

The peer-reviewed proceedings of the conference will be published by Elsevier in *Surface Coatings and Technology*. Further details about SMMIB05 may be found at Web site www.smmib05.net. The next conference in the series will be chaired by D.C. Kothari, University of Mumbai, India.

JOHN BAGLIN,
IBM Almaden Research Center

DARYUSH ILA,
Alabama A& M University

AHMET ÖZTARHAN,
Ege University

MS&T'05 Explores Materials from Research to Application

The Materials Science & Technology 2005 Conference and Exhibition (MS&T'05) was held September 25–28, 2005, in Pittsburgh, Pa. It was organized by ASM International, the American Ceramic Society, the Association for Iron & Steel Technology, the American Welding Society, and The Minerals, Metals & Materials Society and held in conjunction with the ASM Heat Treating Conference & Exposition.

MS&T'05 brought together researchers, engineers, business owners, and technicians for a program of more than 40 symposia covering computational methods, emerging technology, materials science, processing and manufacturing, and surface engineering. Presentation topics ranged from cutting-edge research and development to applied industrial practices.

In a special forum on nanotechnology, U.S. Science Advisor John H. Marburger presented his perspective on the federal budget and priorities for the nanosciences. Every two years, the U.S. National Nanotechnology Advisory Panel assesses the country's National Nanotechnology Initiative. In its latest report, released in May 2005, the panel favored the government's interagency approach and funding level and concluded that the government's advocacy of diverse areas of study is better than a focused few areas of research. Marburger said that the United States dominates the patents in nanotechnology. He said that the research focus in the nanosciences varies in different parts of the world. The United States and Europe pursue research in a number of areas of nanotechnology, China focuses on nanomaterials, and South Korea and Taiwan focus specifically on nanoelectronics. The U.S. private sector, he said, tends to focus on nanotechnology in the biomedical and life sciences and in materials, including metals.

Christopher Snyder, AIST volunteer from U.S. Steel, looks on as Pittsburgh-area high school students cast miniature pewter soldiers during ASM Materials Camp–MS&T'05.

Before research results are ready for application, Marburger anticipates that studies in the areas of nanocomposites, nanomembranes, catalysts, solid-state chemistry, and biosensors will require another 1–5 years; drug therapies, medical imaging, and cost-effective solar cells will require 5–10 more years; and drug delivery through cell walls, molecular electronics, and energy conversions will require 20 or more years.

Patricia Dehmer, director of the U.S. Department of Energy's Office of Basic Energy Sciences, said that the world's energy needs will double by 2050 and that the coinciding future demand for clean energy sources cannot be met by current technology. She said that nanoscience and nanotechnology are critical to energy research since energy conversion occurs at the nanolevel. The goals of her office for energy security, Dehmer said, are to provide the basic science foundations for new and improved energy technologies that ultimately will reduce U.S. dependence on energy imports, reduce greenhouse gas emissions, increase the efficiency and capacity of energy sources, and diversify these

sources. She said the field is wide open for ideas, particularly for research on controlling electrons and photons across energy materials.

In the plenary session of the symposium on "materials for the Hydrogen Economy," JoAnn Milliken, chief engineer of the DOE Hydrogen Program, said that her office is focused on producing hydrogen from diverse, domestic sources as part of the U.S. strategy to replace imported petroleum as an energy source for light duty vehicles. The government has spent the past three years, she said, planning and developing a roadmap for research and development leading to a 2015 industry commercialization decision and the beginning of market penetration by 2020.

Among the materials goals discussed in this symposium were improving catalysts and membranes for hydrogen production, and developing compressed and cryo-compressed hydrogen storage systems for the near term, and solid-state and chemical hydrogen storage materials for the long term. The DOE delivery activity is exploring gaseous, liquid, and hydrogen carriers (chemical entities other than the H_2 molecule) for hydrogen delivery. Mark Paster of the DOE Hydrogen Program said that the department will soon release a delivery components spreadsheet that will serve as a useful modeling tool for materials researchers in this field.

In a symposium on materials education, Rustum Roy of the Pennsylvania State University said that materials researchers pioneered the process of interdisciplinary scientific research, and they must now be the pioneers in pre-college science education to improve the system. Donald L. Evans of Arizona State University gave the status of the K–14 education program MAGSET, Materials as the Gateway to Science, Engineering, and Technology. This project introduces materials as the basis for science literacy to educators and students.

Also in the education symposium, Peter Goodhew of the University of Liverpool, England, and David Brandon of the Technion, Israel, each addressed the topic of what makes a good materials engineer. Goodhew demonstrated an on-line resource designed to enable college students to operate a virtual industrial site where they convert raw materials (i.e., iron from a basic oxygen furnace) into a steel of the correct composition for a specific use. The students must adhere to the simulated parameters, including costs, set by the industry. While Goodhew relayed the interests of the International Iron and Steel Institute and the European Aluminum Association, Brandon gave the perspective of a small country that operates differently from a major continent such as Europe. Israel relies on selling products globally, Brandon said; therefore, students in materials engineering need to supplement their technical education with broad communication skills. They need to be able to understand the science and interpret it for lawyers who draft contracts, especially for startup companies. The graduates need to be multilingual as they hone their negotiation skills with suppliers and customers.

Taking advantage of the wealth of materials establishments in the host city, MS&T'05 welcomed the involvement of local industry and university volunteers. The ASM Pittsburgh Golden Triangle Chapter organized and hosted ASM Materials Camp–MS&T'05. The program featured interactive, hands-on, laboratory-based activities designed to introduce materials science and engineering to the 110 Pittsburgh-area college-bound high school students and teachers who attended. Volunteers staffing the exhibits represented the ASM Pittsburgh Chapter, the Material Advantage Student Chapter of Carnegie Mellon University, and the co-sponsoring organizations of AIST, Materials Research Society, NACE, and TMS. □