V Materials Education:
New Tools and Resources

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Symposium V

Materials Education: New Tools and Resources

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Scope of the Symposium

An unprecedented variety of excellent resources readily available today offers opportunities for creating, polishing, and sustaining dynamic, compelling, and state-of-the-art programs in materials education. And new curricula, new software, new web resources, new literature, new lab modules, and new facilities are actively being developed. This Symposium invites innovators in these areas to discuss their works in-progress, and invites presentations of new, successful teaching tools and strategies. It especially seeks to present summaries and reviews of available resources (such as modules online or on CD, or great reference sources) that will be useful for all those seeking to update and enrich their materials education activities at levels including K-14, undergraduate, graduate, continuing education, and community outreach.

Symposium Topics

- Interdisciplinary programs, e.g., nano-bio, eco-science, energy, water resources, environment, economics, etc.
- New software modules and online resources
- Lab modules and class demonstration materials
- Useful web sites
- Distance learning
- Integration of materials topics in K-12, university, and public education
- Assessment of new programs
- Student research as a learning tool
- Shared major facilities for research/teaching
- Community outreach activities. Exhibits. Contests. Public Policy.

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Abstracts

A00163-00333

The Changing Face of Materials Education

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The past decade has seen a substantial growth in interest in learning and teaching in all disciplines, and Materials is no exception to this trend. There have been many reports, in the literature and at previous ICMAT symposia, of problem-based learning, team projects, design activities, interactive lecturing, student-centred learning, computer-based teaching packages, simulations and other apparent innovations. E-learning (now re-named as technology enhanced learning, TEL) is surely here to stay, although many teachers are unclear what TEL actually comprises.

Recently the UKCME completed the most detailed survey ever undertaken of the teaching of Materials — both content and methodology. Although the survey was confined to the UK, many of its findings are applicable to Materials education in many countries. It reveals the extent to which curricula have changed in response to developments in both industry and the student body, and permits us to deduce the extent to which new teaching or learning paradigms have penetrated university Materials education.

A00172-00692

Logistics of Nano-materials — New Training Course in Aerospace Department of Moscow Institute of Physics and Technology

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Logistics of Nano-materials is the course to provide an introduction to the interdisciplinary Programme for Nanosafety which is intensively evolving at the Aerospace Department of MIPT for the System Analyst training. The course is based on the modern logistics concept dealing with the product life-cycle management. The aim of the studies is to give students a multidisciplinary understanding of nano-materials behavior, toxic effects depending on application, residual impact on environment, etc. The areas of understanding can be characterized in a number of categories, which include material properties, impact on people and the environment, handling of nano-materials, business focus. Peculiarities of nano-materials for conventional logistic functions and technologies (such as transportation, warehousing, storage, package, marking and others) are considered. The problem of nano-materials salvage and recycling is analyzed as the final stage of the nano-product life-cycle. Assessment of risks and appropriate safety measures based on the available data are studied as well as the evaluation of "unknown risks" based on the prediction of unknown nano-materials properties and their potential hazards. Students are informed about existing or implementing systems, official and consensus standards, guidelines and best practice ensuring safety of people (both technical personnel and customers) and environment. The development of human and environmental predictive models for effects of nano-materials, wastes containing nano-particles, pollutions due to emergency situation is one of significant elements of the training course. The ability of nanotechnologies to profoundly alter the social, economic and political landscape of our society is specially analyzed from the point of view of the nano-market development in international contexts.

The curriculum of the training course includes basic, vocational and elective studies. The aim of the basic studies is to form theoretical basis for further education in nanosafety (physics, chemistry, computer and engineering sciences). Vocational studies introduce the student into the central problems in question. These are: system analysis, risk management, supply chain management and others. The vocational studies may be compulsory or optional. Students deepen and enhance their knowledge and professional conditions electing narrower specialization in engineering, human, civil or business fields. At the final stage of the training course students are gathered in teams to carry out the joint project. The following projects were presented this year: nano-aerosol detection, techniques of nano-particles trapping and recycling including plasma techniques, simulation of nano-dust spreading in upper atmosphere, ionosphere and nearest space, nano-pollutions caused by aerospace missions, small satellites for nano-pollutions monitoring. Specially invited tutors supported students' activities during carrying out the projects. Highly qualified specialists from research centers of Russian Academy of Sciences, industrial enterprises, logistic companies and MIPT professors were invited as tutors. The students were allowed to use facilities (special equipment, large-scale computers, precise analytical devices, unique software etc.) available in the above institutions.

A00411-00793

Towards an Integrated Science Programme

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Science is no longer studied solely within the traditional disciplines of physics, chemistry and biology; and scientific research today often requires contributions from two or more disciplines. The fields of materials science, biophysics and nanoscience are just a few important examples of interdisciplinary science, and our undergraduate curriculum needs to reflect this changing scientific landscape.

In this talk, I will discuss the new integrated science curriculum being developed at the National University of Singapore, intended for students considering a research career in science. The Integrated Science Programme (ISP) aims to encourage students to think across disciplinary boundaries, and to be able to address contemporary scientific problems from an integrated science perspective. Lectures and activities are organized around central themes in science, such as measurement, change, energy, materials, conservation, and information. The relationships between different disciplines are emphasized, and mathematical and statistical methods are applied to problems across scientific disciplines.

I will also discuss how the ISP has evolved from my own experience in developing and teaching in our Special Programme in Science (SPS) and Nanoscience Minor. The challenges involved in getting our best students into ISP will also be addressed.

A00412-02398

Lifelong Learning Resources in Materials Education for General and Professional Communities

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In this presentation, we address the rising need for awareness of the basic concepts of materials science, engineering and technology, in nearly all sectors of the community besides the technology sectors. Such awareness is surely needed in order to elevate the basis of scientific perception underlying the intrinsically technical decisions and policies of industry, commerce, and government. It would also be a highly desirable asset for the responsibly informed political electorate, and for the writers and producers of the mass media, whose work so greatly dictates public perception of key societal issues. We shall review some of the diverse resources already available for such individuals who seek to learn more, without disrupting their career obligations. At the level of the many already skilled and highly qualified professionals engaged in materials related science or technology jobs, there exists a similar rising challenge: How to sustain the relevance and breadth of those skills and qualifications, while their existing fields of expertise (e.g. metallurgy or ceramics) are experiencing seismic changes in understanding and implementation resulting from an accelerating pace of new research? An even more far-reaching challenge for these populations is the emergence of entirely new high-technology industries and applications (such as sustainable energy resources, bio-engineering, information technologies), which may rapidly displace the industries in which they started their careers. For success (or at least survival), this sector of today's community will have an increasing need for Materials Education opportunities that will keep them and their capabilities current. We have yet to identify good ways to motivate and enable people to seek this extra life-long training without jeopardizing their current jobs. In order to succeed, such Materials Education courses, modules, classes, tutorials, and programs need to be readily accessible, exciting and stimulating, and pedagogically highly effective, and they should generally lead to tangible evidence of accomplishment, that certifies the learner's new proficiency. A very substantial array of just such effective learning resources already exists, involving universities, colleges, institutes, professional societies and entrepreneurial providers. We shall review a sampling of these resources currently available, and discuss some possible models for future development of this fast-growing activity.

A00422-00849

Training Programs of Advanced Sciences and Technology for High-school Science Teachers

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We have developed special training programs of advanced sciences and technologies for high school science teachers. In 2008, the training center for the special programs was established by supporting from the Korean government and over 500 high-school science teachers were trained with the programs. The programs cover the advanced sciences and technologies of NT, BT, ET, and IT. The programs mainly consisted of three parts; 1) illustrations of the principles for new technologies with high-school level science knowledge, 2) performance of simplified experiments, and 3) visiting national facilities. The programs provided great opportunities to the high school teachers for understanding new sciences and technologies. We have also developed experimental kits for high-school science classes.

A00492-00902

Thinking Big: Science and Math Education on the Scale of Millions

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Many strategies for improving math and science education in the U.S. have relied on small scale interventions: classroom-sized teacher professional training experiences, school-district-sized curriculum innovations, math and science summer camps for a few hundred youth, regional science and math clubs/competitions—strategies that rarely reach more than 1000 students at a time. The approach of using many small-scale innovations in parallel, each sponsored by a different altruistic organization, is in part a reflection of the difficulty of scaling educational interventions in countries (such as the U.S.) that have no national education system. When scaling is attempted, it becomes prohibitively expensive for any one organization to undertake: the number of human salaries tends to scale linearly with the scope of the program, especially in interventions requiring one-to-one human contact. The frustrating reality is that the need to improve math and science education far exceeds our capacity to deliver. It is a national need, one that requires reaching tens of millions of students at a time. To date, the small-scale interventions, as plentiful as they are, have not been able to "move the dial" any appreciable amount at a national level. This presentation discusses two strategies for reaching millions of students at a time: mobile (cell) phone-based learning and videogame based learning. In our Sports Bytes program, which used mobile phones as the content delivery vector, we were able to scale up from 40 participants to over 100,000 in less than a year. A subsequent agreement with a national wireless carrier then took the program to millions of individuals nationwide. However, it remains to be seen whether the depth of learning achieved in the classroom can be replicated on a small hand-held device. In the area of videogame-based learning, we are again seeing usage rates in the millions. For example, the science-and-math-themed virtual world Whyville currently serves 4 million children, predominantly girls. The sparse research on videogame-based learning is encouraging, though, as it demonstrates learning outcomes that easily surpass those of lecture and are similar to those of inquiry-based learning. Moreover, certain videogames, such as River City, have demonstrated that videogame-based learning can almost completely close the achievement gap between strong and weak academic performers. This presentation closes with a discussion of the Kauffman Foundation's strategy for ensuring these massively scalable education strategies become a dominant force in math and science education.

A00499-00915

Mentoring Early Career Researchers: How to Survive in the Multi Faceted World of Modern Science

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The aim of this presentation is to describe the graduate course on "Survival Skills for Scientists" developed at INRS. The central theme of the course is that succeeding in Science requires skills beyond those needed for Science. Competition for jobs, funding and resources in general has become extremely tough over the last decade. We thus advocate the need to mentor early career scientists beyond their work in the laboratory, so as to develop soft professional skills that will make them more competitive. The course offers basic career advice to graduate students and post-docs and discusses other themes of importance for their education. The main topics for discussion are as follows:

- the job market for science and engineering graduates;
- comparing different work environments such as industry, government labs and academia;
- career planning;
- 'playing chess';
- finding a mentor;
- the peer review system;
- communicating your Science (giving presentations, writing articles);
- funding your Science;
- women in Science and Engineering
- The two body problem
- Ethics in Science.

A00609-01109

Development of a Multimedia Based Professional Science Master's Program in Materials and Chemical Synthesis

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The advancement in the design and development of materials with desirable properties occupies a central place in addressing many industrial and technological challenges of modern time. Many novel synthetic strategies, innovative characterization techniques, and computational methods have been introduced in the recent years to help meet the demand of producing a wide variety of materials, especially those of potential commercial values. Some of these new developments are still confined to research laboratories and primary literature. While traditional materials' education programs rely on specialization in

one of the core areas, recent success stories of industrial innovations have demonstrated that knowledge in all key areas is crucial to meet the developmental demands of the industry and the society. Realizing this situation, we have developed a new graduate degree program in Materials and Chemical Synthesis which cuts across the traditional disciplines covering all core areas to prepare professionals for undertaking the new challenges. The program, which fills a major gap in the higher education curriculum, combines the latest tools and techniques in the design, synthesis and characterization of materials with computation and simulation methods, program management, technical communication and intellectual property management. The program is offered nationwide via TV and internet. It attracts a wider cross-section of working professionals from Industry and academia.

A00672-01212

Materials Education "San Frontières' - The Development of Opportunities for International Exchanges and Joint Degree Programmes at Both Undergraduate and Postgraduate Level

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This conference and the research and education symposia therein, are manifest evidence of the truism that both education and research are international. Indeed there has taken place a remarkable "internationalization" in the University research process in the last few decades, driven by the recognition that the research question is answered most effectively and most rapidly by accessing the best expertise and resources, wherever they may be. This process has been encouraged by funding models that encourage international collaboration and by the advent of (relatively) cheap air transport. In Europe, for example, a significant part of the research effort is based on EEC funding (European Economic Community) rather than domestic funds.

It is perfectly normal for a PhD student to collaborate with one or more international research laboratories during their period of study, perhaps spending periods of several months there. The current economic crisis may ameliorate this trend to a certain extent; also students who might have gone overseas for their PhD, may choose to study at home, and make a trip to an overseas lab for a shorter period instead. Thus postgraduate exchanges and joint postgraduate degrees may emerge in greater numbers and there may be a competitive advantage in terms of recruitment to those institutions that offer such opportunities.

The benefits of a period of study away from home have also been recognized at the undergraduate level and exchange programs and joint degrees have become very popular, giving the students involved many assets in an increasingly competitive job market, for example a second language, increased confidence and maturity. Again such programs may offer participating institutions competitive advantage.

In this paper I will explore these developing trends in the field of Materials, and I will explore the implications for the staff and students involved.

A00719-03552

Interdisciplinary Research and Education - UNM IGERT Program on Integrating Nanotechnology with Cell Biology and Neuroscience

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The Integrative Graduate Education and Research Traineeship (IGERT) program supported by the National Science Foundation seeks to train scientists and engineers to address the global questions of the future. Through the use of innovative curricula and internships, and by focusing on problem-centered training, these programs give their graduates the edge needed to become leaders in their chosen fields.

The overarching vision of a new model of education implemented by the IGERT program on Integrating Nanotechnology with Cell Biology and Neuroscience (INCBN) at the University of New Mexico (UNM) is to develop a new cadre of interdisciplinary scholars with excellent research skills, prepared for 21st-century challenges brought by the nanotechnology revolution. The program fosters collaborations between science and engineering faculty and School of Medicine (SOM). It creates a collaborative network linking engineering, medicine, and science in order to create the critical mass necessary for multidisciplinary education of students who will apply advanced scientific concepts to biological problems.

The predominant focus of the INCBN IGERT program is on development of novel research tools enabled by nanotechnology and their application to solve importsnt questions in cell biology and neuroscience. New information about molecular and cellular processes revealed by nanoprobes and nanosensors is expected to result in a string of scientific discoveries that will dramatically improve our understanding of basic mechanisms in biology. In the long range, this will significantly improve the depth of our understanding of the cell and molecular processes critical to learning, memory, and behavior, and of those that underlie pathological changes in disease.

The INCBN IGERT program currently assembles over 30 faculty from 9 different departments, spanning 5 different colleges: School of Engineering, College of Arts and Sciences, SOM, College of Pharmacy, and College of Education.

The major features of the INCBN IGERT program are:

1. It identifies a comprehensive interdisciplinary theme of integrating nanotechnology with cell biology and neuroscience, a very fertile ground for doctoral-level research, that serves as the foundation for traineeship activities.

2. It integrates interdisciplinary research with innovative graduate education and training, curricular enhancement, and co-advising by faculty from science/engineering and SOM, to foster strong interactions among participating students and faculty.

3. It provides a broad interdisciplinary knowledge combined with strong disciplinary basis, instruction in ethics and the responsible conduct of research, and opportunities to participate in collaborative research with international partners in Germany and Australia.

4. It uses available expertise at the College of Education to conduct formative assessment of its effectiveness and to critique and improve the program based on these data.

5. By giving the INCBN IGERT Trainees access to research facilities available at participating departments and research centers, the program creates an environment in which students are exposed to a broad base of experimental concepts and techniques.

6. The Annual INCBN Symposium popularizes the program within and outside UNM. Results are also widely disseminated through publications and website development.

Acknowledgment:
The INCBN IGERT Program at UNM is supported by the National Science Foundation (Grant No. DGE-0549500).

A00860-04997

Re-Inventing Electronic Materials Laboratory Classes through Paintable Devices: Transistors So Simple, a Child Can Do It

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Organic semiconductor electronics is considered a technological approach to cheaper and more flexible components. It is less apparent that the more facile fabrication possibilities for organic electronics can be capabilities in themselves, in that they become activities, rather than simply process steps. Some of these activities can be carried out by untrained students. Thus, students who may be studying elementary electronics can make their own semiconductor devices for testing as part of laboratory courses. As they test devices, they gain insight into the origins of semiconductor activity that is reinforced by the hands-on experience of having deposited and patterned the materials. This talk will describe experiences of high school and undergraduate participants in laboratory and research studies involving organic semiconductors, including transistors, diodes, and sensors that they have produced and evaluated. Prospects for packaging the materials and documentation into modules for even younger students will be considered.

A00863-01498

Mentoring New Faculty: Important Yet Often Ignored

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Excellent mentoring is a key factor in developing excellent faculty members. A confluence of several factors has made mentoring especially important today. Importance and need for healthy mentoring activity is stressed by many yet, the roles and responsibilities of mentor and mentee, as well as description of effective mentoring activity are difficult to find in a single source. This presentation will focus on roles and responsibilities of mentors and mentees in establishing and maintaining a productive mentoring relationship. Research indicates that new faculty who are helped by a mentor perform better both as teachers and as researchers. This, in turn, strengthens and enriches the academic unit and the institution. Although the roles of mentor and mentee vary depending on the culture of the people, institution, and academic unit, certain general guidelines may be applicable to all and yet others may be adopted for local conditions. The paper will discuss the roles of mentor, mentee, department chair (or supervisor), benefits to mentee and mentor, along with process, assessment, and examples of productive mentoring activities.

A01054-01829

Value Oriented Materials Science Education — The Need Of The Century

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The world has witnessed two major wars and many battles and still we witness battles which indicate that present day education has failed to achieve its major objective. Education, no doubt, has touched the BRAINS but not the HEARTS of men and women in many parts of the world.

Every day we come into contact with many thousands of manufactured objects that are essential to modern life: the vehicles that we travel in; the clothes that we wear; the machines in our homes and offices; the sport and leisure equipment we use; the computers and phones that we can't live without; and the medical technology that keeps us alive. Everything we see and use is made from materials derived from the earth: metals, polymers, ceramics, semiconductors and composites.

To develop the new products and technologies that will make our lives safer, more convenient, more enjoyable and more sustainable we must understand how to make best use of the materials we already have, and how to develop new materials that will meet the demands of the future. Materials Science and Engineering involves the study of the structure, properties and behaviour of all materials, the development of processes to manufacture useful products from them, and research into recycling and environmentally friendly disposal.

The human-centered, "green" education possesses four essential qualities, namely,

- Experiential Learning
- Community Development
- Concern for the inner life
- Ecological literacy

In this model of education VALUES are imparted to the learner as and when he/she learns the lesson on MATERIALS. Though VALUES cannot be taught as it has to be caught, we propose a model lesson in MATERIALS SCIENCE where VALUES are imparted along with the main lesson for a cognitive-affective process. Unless we start introducing new approaches in the framing of curriculum for MATERIALS SCIENCE we will be in a sad state of affairs as we live today in the world of globalization. By all means we have to stop all types of conflicts that divide the world into rich and poor. This is the felt need of this hour in all disciplines of education.

A01450-03799

Relations between Science Education, Research and Economic Prosperity

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The correlation between education and economical strength at a national level has been frequently claimed and suggestive arguments for it have been given the published literature. These conclusions are mainly based on "common sense" arguments and derived on case study examples. The caveat of subjectivity has not been seriously regarded in these studies. In this contribution an attempt is made to approach this topic at a more objective, independent and quantitative level. Here, use of the statistical data published by the OECD as well as the UNDP Human Development Reports is made and composite indicators such as e.g. the human development index, technology achievement index and education index are used to find correlations between economical strength and education indicators. The analysis is made for the categories leading countries, potential leaders, dynamical adopters and developing countries and focuses on the role of technology implementation especially for emerging countries.

A01501-02612

Enabling Activities for Photovoltaics Industry Expansion for the Asia-Pacific Region

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The University of New South Wales has carried out silicon solar cell research since the mid 1970s, when it achieved world recognition. The UNSW solar cell research group has led international commercialisations and, since 2000, pioneered specialised undergraduate education in photovoltaics engineering. The Photovoltaics and Solar Energy undergraduate program is a four year full-time Engineering undergraduate program covering device theory; photovoltaic technology and manufacturing; photovoltaic applications and system design; policy, analysis and modelling; renewable energy technologies and sustainable energy.

Approximately half the material in the Renewable Energy Engineering undergraduate program is in common with the Photovoltaics and Solar Energy program, it encompasses a

broader range of renewable energy technologies including solar thermal systems, wind turbines, biomass, and also the important areas of solar architecture and the design of energy efficient housing. Both can be combined with a Bachelor of Science, Bachelor of Commerce, Bachelor of Arts or Bachelor of Laws.

The School also offers four postgraduate coursework programs: Graduate Certificate, Graduate Diploma, Master of Engineering Science and Master of Engineering Science (extension) and two research programs:- a Masters by Research and a Doctor of Philosophy.

In 2007, the School has been fortunate to secure Australian Government support under the Asia-Pacific Partnership on Clean Development and Climate (APP) for sponsorship of undergraduate students from selected Chinese universities and postgraduate coursework and research students from China, India and South Korea. The first groups of these students started in early 2008. The undergraduate students, who complete their first two years of study in China, were drawn from Nankai University, Tianjin and Sun Yat-Sen University, Guangzhou, and Zhejiang University, Hangzhou has since been added for 2009. Additionally, the final intake of APP-sponsored Master of Engineering Science students from China, India and Korea joins UNSW in the first semester of 2009.

Asia-Pacific students are also joining the rapidly growing School through other sponsorship and by private means, including from Singapore, where the Economic Development Board sponsors research students. Articulation arrangements have been agreed for Singapore Polytechnic and Ngee Ann Polytechnic students to be able to transfer to UNSW following diploma graduation.

The School has also developed modules for teachers and students for photovoltaics education at senior high school level and these were launched in 2008 and are freely available.

One of the School's text books, "Applied Photovoltaics", has been published in 2008 in Simplified Chinese language through Shanghai Jiao Tong University Press and is intended to be published in Traditional Chinese and Korean too. Others of the School's texts are also in preparation for publication in Asian languages.

In addition to education, two other industry-enabling activities are the development and management of standards for hardware and systems quality and technical training and accreditation of system designers and installers. Australia's efforts on these aspects will be briefly described as possible models for some other economies.

A01507-02619

Status of Materials Education for Graduate Students and Young Scientists in National Institute

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The Doctoral Program in Materials Science and Engineering has been jointly operated between the University of Tsukuba and the National Institute for Materials Science (NIMS) since 2004. The joint program has been managed mainly by NIMS, unlike other cooperative graduate schools. At first, educational activities by national institute were somewhat controversial, but, year by year, the significance of education in national institute has been appreciated. Selected scientists from NIMS, now 27 researchers, who mostly are running national programs, are involved in the graduate school faculty and supervise students' research for the PhD degree. The program aims at educating students to become highly professional engineers or scientists in Materials Science and Engineering through hands-on research experience using the advanced experimental facilities and by participating in the major research projects. It has been agreed that the students' participation in the research projects under the supervision of leading scientists is mutually beneficial between the students and the supervisors. The program also emphasizes on interdisciplinary and international environments of research and education. We have expanded full-English lectures from the topical subjects to the fundamental disciplines for the master's courses, which is unique in Japan. By virtue of this policy, eligible students are applying for the program from all over the world. The NIMS has also operated an international center for young scientists of postdoctoral level, which provides them with the higher career paths. Although the overall education systems appear to be seamless and successful, there are some concerns. Although overseas students are welcome, it is a pity that domestic students do not seem eager to enter the MSE program. Even after the enrollment, most of the Japanese students of master-course tend not to go on to the PhD course. It is a universal unfortunate trend in Japan. One of the reasons may be concerned with the overall trend in "Disinterest in Science" in Japan. Lack of good career paths also contributes to this unfortunate trend. Losing capable young people's attention is one of the most serious problems in the field of materials science. We wish the graduate education in national institute could create a stir in this trend.

A01550-02700

Life-Long Professional Learning for Professional Viability and Growth

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Today's individual scientist and engineer can expect to change their technical field and/or employer several times during their career. They will therefore need to expand or refresh their knowledge base repeatedly as they transition from one job or technical area to another. This applies in particular for those in industry, but may also include those in academia or government as technology advances or the whims of politicians and the realities of commerce change the funding of R&D. The resources needed to accomplish this are part of the focus of this discussion. The sources of knowledge include text books, hand books, journals, magazines, conferences, short courses, colleagues, and consultants. Some of the advantages and disadvantages of these will be considered. The availability or access to many of these will also be considered.

Professional societies can play and do play an important role in the continuing education of professionals through conferences, short courses, publications, and networking. Some of the positive and negative attributes of professional societies in this role will be discussed. Some of the activities of the Professional Subcommittee of the ASM International Education Committee will provide specific examples of how a professional society can provide substantial assistance to a transitioning or developing scientist or engineer. These activities include the review and revision of current courses, addition of new courses, the development of university approved courses, continuing education units for virtually all courses, and cooperation with other societies in offering courses. Some of the problems faced by the Subcommittee in accomplishing their goals will also be discussed.

A01696-02951

Developing a Strategy for Materials Science in Germany - Results of a Dephi-Study for a Materials Roadmap

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Materials science can be viewed as supplying discipline to research disciplines "downstream" the "value chain" which is closer to applications or products. Nevertheless, most research disciplines in natural sciences or engineering are highly dependent on high quality fundamental research in the cross cutting field of materials science. However, in spite of the high relevance of the findings in materials science for product and application related researches, successes in materials science rarely receive the same visibility in society. This lack of visibility is often the reason for neglecting materials sciences in research funding.

A second Problem is the fact that the materials science community often fails to speak with one coherent voice to different institutions in their environment. Different interest groups with overlapping and competing motivations only partly ensure that the voice of Materials science is heard by addressees in society or politcs. The result is the lack of a strategic focus of materials science. As reaction to this shortcoming regional, national and transnational institutions have been created in order to consolidate the community and institutionalize the strategic orientation.

Throughout the world these institutions have identified this shortcoming of long term strategic research agendas for materials science. The development of long-term strategies (e.g. roadmaps) for materials science is gaining importance for the materials community around the globe. Latest examples include EU technology platforms like SusChem, EuMat, and MatUK as well as the increasing use of roadmaps in private companies or industries as in the semiconductor industry. Furthermore, there is a wide range of roadmapping activities in fields that often depend highly on materials research - e.g. nanotechnology, automotive, health-care.

The contribution will give an overview on the formation of the German umbrella organization MatWerk — an institution which integrates different scientific associations engaged on the field of materials sciences. A central objective of this organization is the establishment of a continuous roadmapping process for materials science in Germany. The contribution will describe this process by the example results of this roadmapping process for fundamental research needs for glass materials. One aim of the project is to uncover the future potentials of different technologies in the field of research on glass materials. The contribution will also give an outlook on how these results can be utilized by research funding organizations and the scientific community.

A01942-03349

MatDL: The Materials Digital Library Pathway

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As part of the NSF-supported NSDL, MatDL Pathway (http://matdl.org) assumes stewardship of significant content and services to support the integration of research and education in the materials community. MatDL is a consortium of organizations including: Kent State University, MIT, National Institute of Standards and Technology, University of Michigan, Purdue University, and Iowa State University, and focuses on serving materials undergraduate and graduate students, educators, and researchers. In addition to providing a Repository, MatDL offers the materials community: 1) tools to describe, manage, exchange, archive, and disseminate data among national and international government-funded materials collaborations (teams, centers, and institutes); 2) services and content for virtual labs; 3) workspace for open access development of computational materials modeling and simulation tools; and 4) workspace for collaborative development of core undergraduate materials teaching resources. MatDL is expanding its collaborations across the materials community through joint efforts with the ChemCollective (CCLI Phase 2) and professional societies such as the Materials Research Society (MRS) and the Minerals, Metals & Materials Society (TMS). A primary goal of MatDL is to help integrate research and education. By offering materials educators convenient access to relevant, shared learning resources based on research, both teaching and learning within materials and cognate disciplines are positively impacted.

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A02020-03479

Development and Use of Online Teaching and Learning Resources — The DoITPoMS Project

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DoITPoMS (Dissemination of Information Technology for the Promotion of Materials Science: www.doitpoms.ac.uk) is a web-based teaching and learning resource developed by students and academics. The electronic resources available include libraries of videos and micrograph images along with approximately 50 online tutorials (Teaching & Learning Packages, TLPs) covering a wide range of topics relevant to Materials Science. Packages are primarily focused at an undergraduate level and are designed to provide useful resources for both learners and teachers. This presentation will examine both the development and use of the resources.

The main mechanism for the development of teaching & learning packages is via an annual summer school, based in the Department of Materials Science in the University of Cambridge. The summer school, funded through the UK Centre for Materials Education, involves students and academics from Cambridge and from a number of other UK partner institutions. Packages are overseen by members of academic staff who have overall responsibility for the resources, though much of the development work is carried out by students, whose role is to develop resources which aim to present the topic in an appropriate format for the web environment and at a level which is aimed at their peer group. The partnership between academics and students is an excellent mechanism through which to develop the resources. In addition to ensuring high quality resources, there are other advantages to the students and the Department, which will be explored in this presentation.

It is important to consider how the resources are used by both students and academic staff. In addition to being a resource which can be used by independent learners, it is important that the resources produced can easily be integrated within structured courses, such that they become an integral part of the teaching and learning process. Hence the packages need to have flexible elements which can be taken and adapted in order to support teaching. The presentation will conclude with plans of how we aim to promote the wider use of such resources by taking advantage of developing web-based technologies (commonly known as Web 2.0).

A02064-03549

Designing Undergraduate Courses that Explore the Interplay of Science, Technology, and Societal Impacts

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Two new undergraduate courses have been developed at UCSB that explore the intersection of innovative technologies and their impacts on society. The distinctiveness of these INSCITES (INsights on SCIence, TEchnology and Society) courses is that they are built around a single technology theme (e.g. Surveillance Technologies, Green Technologies) that highlights science and technology in its social and technical context. In addition, the courses rigorously address both the science and technical content as well as the historical and societal aspects of current technology through the inclusion of hands-on science and social science laboratory activities. The first INSCITES course was titled "YouTube and Other Big Brother Stories: Technology and Culture of Surveillance in Modern Society." The course covered six topics addressing different aspects of surveillance technologies: Biometrics, Chemical Surveillance, Environmental Surveillance and Epidemiology, Computer/Internet Surveillance, GeoTracking, and State Surveillance. The second INSCITES course was "Green Works: Exploring Technology and the Search for Sustainability" and contained five modules exploring several sustainable technologies: Light Emitting Diodes/Sustainable Lighting, Green Car Technologies, Solar Energy Technologies, Battery Technologies, and National and International Energy Policies. The primary goal of INSCITES is to increase the technological literacy of undergraduate students at UCSB to enable them to make better-informed decisions about technology and its impact on their lives. These courses are designed as general education classes for undergraduate students, and thus have no prerequisites. The motivation to build these courses around one technology theme is the desire to attract a wide range of students with many viewpoints and expertise represented in the class. This goal was realized in the first two years as in each year the class composition was approximately 50% science and engineering students and 50% social science and humanities students, with a large percentage of these students from underrepresented groups in science and engineering. Each course was designed around four pillars: science, technology, history, and societal aspects. All of the pillars were covered approximately equally in each course. An additional goal of the INSCITES project is to introduce the next generation of science faculty (UCSB graduate students) in curriculum development, effective teaching, and accessible communication of science and technology to the general public. Graduate Teaching Scholars reported that the unique experience of designing an interdisciplinary course from the bottom up gave them new experience and confidence that they could design their own courses and continue to innovate in their future teaching careers. In fact, subsequent evaluation of the Graduate Teaching Scholars shows that the INSCITES experience has influenced their intended career path.

A02196-03762

Information Communication Technology Enabled Model for Quality Distance Learning

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The present paper aims to describe an Information Communication Technology (ICT) enabled model for imparting quality distance learning programmes. The development of the ICT enabled model is based on the research survey carried out on the basis of the case studies of the open and distance learning Universities in the Central India. It is quite revealing from our findings that the ICT enabled model plays a vital role in introducing the flexibility, accessibility, equity and quality in distance learning programmes. The results of the analysis and execution of the proposed ICT model shall be presented and discussed in detail. The present ICT tools used in our model consist of the computers, internet, wireless communication technology and competent software capable to process, create, disseminate, store and manage data and information. The rapid advances and revolution in ICT have drastically reduced the cost of transmission of the digital information anywhere in the world and enabled the distant learners to get the benefit of the modern ICT in 21st Century. The ICT has truly revolutionized the teaching and learning process. The interactive ICT has brought to the distance learners, a virtual class room facility with intense interactivity and the sharing of resources and knowledge. Thus, the Open University system has responded to the demands of this ICT era, where every body has access to the knowledge and information and everybody has opportunity to learn and grow without limitations of space, time and borders. With this a remarkable shift has occurred in the process of education, where learners have no longer to go to Universities, but the Universities will go to the learners. These problems will be greatly addressed to provide education with access, equity and quality during the presentation.

A02245-03859

Development of Lecture/Lab Materials for Nanotechnology and Chemistry Session of Advanced Science and Technology-oriented Education (ASTOE) Program in Korea

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In order to improve the understanding of up-to-date scientific information and technology for high school science teachers, Advance Science and Technology-Oriented Education (ASTOE) program was developed in Korea. Topics of nanotechnology and chemistry session for ASTOE program were selected by utilizing the analysis of the high school textbook contents and the survey concerning to ASTOE program of 100 middle school and high school science teachers. Topics selected by these processes are 1) green chemistry, 2) synthesis of zeolite A builder, 3) preparation of conducting polymer coated polyester, 4) synthesis of gold- and silver-nanoparticle, and so on. Some lecture/lab materials for green chemistry including applications of microwave enhanced reactions, sonochemistry, supercritical fluid, and biodiesel will be described in this presentation. And lecture/lab materials for synthesis of zeolite A builder, preparation of conducting polymer coated polyester and synthesis of gold- and silver-nanoparticle will be also described. The feedback of the topics and the future direction of the workshop will be discussed. It has been found that ASTOE program is very helpful to the teachers who want to teach up-to-date scientific information and technology to their students.

A02293-03911

Italy-USA Joint Doctorate Program in Materials for Environment and Energy: Achievements and Hurdles

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The Ministry of University and Scientific and Technological Research (MURST) of Italy (now Ministry of Education, University and Research, MIUR) in 2000 funded a proposal on an Italy-USA joint Doctorate Program between the University of Rome Tor Vergata (UTV) and the University of Florida (UFL). For the academic year 2001/02, UTV decided to start a new Doctorate Course on Materials for Environment and Energy. The discussion amongst the two Universities started at the same time, and finally an agreement fixing the rules for the joint Program was signed in 2004, with some delay due to the enormous differences existing between the academic organisations of the USA and Italian Universities at the graduate level. Nevertheless, the exchange of students started earlier, even though the first Italian student engaged in the program got only the Italian title, due to the delay of the bureaucratic procedures. An US student was the first to achieve the joint degree in May 2006, while the first Italian student succeeded in July 2008. This presentation is intended as an evaluation of the first years of joint activity, to show achievements and hurdles, advantages and disadvantages for both students and teachers.

A02322-03973

ET-based Course Connecting Teachers in a Classroom to the Real World

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We developed the ET-based lecture/lab materials to meet the learning needs of the teachers in Korea. The course was developed as one of the “training program of the advanced sciences and technologies for high school teachers”. Course covers from the basic but ambiguous concept to new scientific issues in Earth Science including astronomy. Several selected lab materials that captured the interest of passionate teachers will be introduced. We show whether, and how, teachers’ views towards Earth System were altered by the course. The qualitative data on the questionnaire will also be discussed.

A02552-04364

Living and Learning Experience — Character Education

Haydn CHEN
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In the historical perspective, the 21st century represents an era of rapid changes with unprecedented rate in knowledge, technologies, economy, ecology, information, globalization, etc. It behooves those of us who are involved in tertiary education to re-examine our roles, our curriculum, our course contents, and more important how could students with different culture, background, regions, and disciplines be educated with global vision and truly become world citizens. Not because we wish the earth is flat so characters are to be uniformed as well. To the contrary, there is an even higher need to preserve the local culture and civilizations of ones own, but at the same time can appreciate and treasure those of others. Diversity and

multicultural education must be emphasized. In the recent collapse of financial sectors that had insurmountable effects worldwide, educators could not help to think of the ever important topics of ethics, good practices, accountability and other aspects of virtues and characters. How can a university education manage to include these components in the curriculum, to educate students with not merely the knowledge, but the wisdom and the willingness and ability to do good deeds? This is undoubtedly a major endeavor that university must take. As in an old saying "future is in the hands of the young", yet "the education is in the hands of us". We must face up the challenges and provide sound visions and practices to our young. In this talk, some activities taken by the Tunghai University, such as Student Labor Programs, Service Learning, School for Liberal Arts Learning, Living and Learning in the Residence Halls, etc. will be presented to illustrate our efforts and accomplishments. In turn, we look for feedbacks, comments and suggestions to further advance our programs in Living and Learning for character education.

A02881-05039

New Bachelor of Philosophy Degree at the Australian University: A New Way of Engaging High Performance Students in Science and Engineering

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In this talk, I will introduce the Australian National University and its original charter as the research-only University, and how the teaching part of the University was initiated, and most recently how both research and teaching parts of the university were integrated in a college structure. How this integration is providing unique learning opportunities to students. Then I will introduce our multidisciplinary engineering department and its integrated engineering program which covers materials engineering, photovoltaics, systems engineering, robotics, telecommunications engineering. Then I will present our new Bachelor of Philosophy degree program and how this is allowing us to attract high achieving school leavers into science and engineering programs at the University and providing students flexible learning opportunities. Will this new BPhil program retain students at the University to do their PhD at the ANU? I will also present our learning-by-research initiative introducing undergraduate students to research methodology early in their career. I will conclude the talk with the importance of science communication and how science communication is integrated into our Honours program.

A02980-05095

Some Aspects of International Collaboration in Materials Science

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Not available at time of print

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