Results of the Materials Genome Initiative Strategic Scoping Session

Organized by The Minerals, Metals, and Materials Society (TMS)
In conjunction with MS&T'11 Conference

INTRODUCTION

The objective of the *Materials Genome Initiative for Global Competitiveness* is to provide the United States with the infrastructure, workforce, and innovations needed to reduce significantly the time and cost to discover, develop, manufacture, and deploy advanced materials. To achieve this goal, the materials community must embrace innovation practices that encourage collaboration among government, industry, academia, and professional societies. The Materials Genome Initiative (MGI) will develop and support a coordinated effort to establish the infrastructure and protocols needed to facilitate these collaborations, and realize this vision.

In an effort to build the foundation of a future materials innovation infrastructure, MGI requires that it is assembled by the representative voices of government, industry, and academia. The Materials Genome Initiative Strategic Scoping Session at the MS&T'11 Conference served as a meeting place for 45 members of industry, government agencies, and academia, representing 13 engineering and scientific professional societies, to discuss the necessary actions to achieve the goals of the MGI. A listing of the attendees is included as an attachment. Representatives met in small groups for two hours, to address two focused questions:

- "What actions can be taken to reduce the barriers to collaboration among academia, national laboratories, and industry, thereby accelerating progress from discovery to deployment?"
- "What are the most critical characteristics of a future Materials Innovation Infrastructure?"

This report presents a summary of the findings of this workshop.

FOCUS QUESTION #1: What actions can be taken to reduce the barriers to collaboration among academia, national laboratories, and industry, thereby accelerating progress from discovery to deployment?

1. Develop a language and taxonomy for data collection and sharing.

The ability to share data and models with ease relies on a format that is identifiable and transferable across many organizations. Currently, there are no standardized formats for materials and computational data. Industry, academia, and government representatives recognize the need to develop standards and terminology for data sharing, archiving, and collection to minimize the barriers involved with time-consuming data comparison. Developing a standard language and format for the assorted data types will accelerate communication efforts and reinforce positive collaboration practices amongst academia, national laboratories, and industry.

2. **Develop template agreements for intellectual property issues in academia-industry collaborations on materials data and computational tools.**

   The sharing of information can be obstructed or halted by intellectual property (IP) concerns. Most companies and universities handle intellectual property in unique ways, requiring individual negotiations and contracting regarding IP issues for new collaborative agreements. Currently, there is no standard framework for building intellectual property agreements to govern industry-academia partnerships intended to develop materials data and tools. The model/guidance that is used to operate the "Fraunhofer Institutes" in Germany should be studied as a possible prototype. To stimulate and expedite greater collaboration, these partners would benefit from agreement "templates" that reduce the obstacles associated with handling intellectual property.

3. **Streamline export controls (e.g. International Traffic in Arms Regulations) without compromising U.S. interests and national security.**

   The U.S. government enforces rules on the export and import of sensitive information in order to protect the interests and national security of the country. Members of government agencies, academia, and industry are all required to strictly follow these rules and regulations for the transfer of particular types of data, some of which would be part of or benefit from the MGI innovation infrastructure. While export/import regulations are necessary, often these rules can prevent or slow collaboration beyond national borders. In the interest of increasing global collaboration, export controls should be streamlined to reduce barriers to data sharing without compromising national security.

4. **Study other models for open collaboration and benchmarking practices to conduct applied research.**

   Open collaboration and research across sectors is a major thrust of the MGI. In the interest of accelerating the commercialization process by moving from time-consuming and repetitive experiment and characterization loops to a new integrated design continuum, the future materials innovation infrastructure should borrow ideas from vetted innovation models in other disciplines that exercise open collaboration and benchmarking practices. Representatives across government, industry and academia recognize the need to carefully analyze other innovation models in preparation for constructing an MGI collaboration framework.

5. **Construct cross-sector "grand challenge statements," identifying aligned goals and areas where collaboration across industry, government, and academia is vital to meeting important national and global challenges.**

   Identifying the fundamental materials science and engineering challenges that an MGI innovation infrastructure can help to address can play an important role in aligning the community toward clear, real-world applications. Further, given limited funding and expert capacity, aligned goals will provide optimum use of resources, and help to ensure maximum progress in the least amount of time. This "grand challenge" approach has proven successful in other innovation areas and can help focus researchers and engineers in industry, government, and academia on common, compelling challenges that will provide the early cases for MGI-type collaboration.

FOCUS QUESTION #2: What are the most critical characteristics of a future Materials Innovation Infrastructure?

1. **The materials innovation infrastructure features a commercial tool that enables and incentivizes collaborators to put data into a non-proprietary, standard format.**
   A materials innovation infrastructure must feature a data-sharing tool with standards for data format that enable collaborators to share and use the information in an effective and appropriate manner. The creation and use of a commercial tool or web-based application can empower a large audience of collaborators to access a vast database of materials information. Such a system may employ incentives to compensate researchers for data contributions and ultimately should be financially self-sustaining as part of a profitable MGI innovation value chain.

2. **The materials innovation infrastructure hosts a communication platform for stakeholders to collaborate on well-defined, prioritized problems in specific sectors (e.g. energy, medicine, infrastructure) or topics (e.g., "grand challenges").**
   To help spur active collaboration, members of all stakeholder groups must have a platform that allows for efficient, easy communication and information sharing. This platform should provide simple, secure access and may be organized around "grand challenges" or economic sectors as a way to focus users on high-priority applications.

3. **Materials science and engineering education must be increasingly multidisciplinary, with greater focus on product commercialization.**
   The MGI envisions a highly multi-disciplinary approach to materials innovation. To realize this vision, engineers of different disciplines must be able to communicate effectively with one another and with scientists, computer programmers, and other non-engineers working in the MGI infrastructure. Preparing future engineers to communicate and collaborate in such environments requires new skills and educational curricula. A possible aspect of the educational curriculum involves a virtual learning approach that provides incentives for students to share data and ideas, making the sharing of data an integral part of learning.

4. **The materials innovation infrastructure features greater shared use of computational, experimental, and testing facilities, and provides open access to resulting data.**
   Computational, experimental, and testing facilities are large capital investments that satisfy the needs for materials research, testing, validation, and certification. Many such facilities exist around the world, with varying degrees of capacity utilization. Sharing or leasing these facilities, rather than building new, dedicated ones, can allow for faster progress at lower overall cost, but no framework currently exists to govern this type of collaboration. Ultimately, "centers of excellence" could be established with open access to MGI stakeholders, thereby eliminating unnecessary redundancy across the community while ensuring adequate facilities to meet the community's needs.

5. **Data in the materials innovation infrastructure includes information regarding the pedigree of the material and a level of confidence in the data.**
   If a material must undergo validation and certification for one application, it would save time and money to make the material's response and properties measured during that validation available to

other researchers considering the material for different applications. Such data is most valuable with context provided by the pedigree of the material and documented confidence levels for the data, as different applications demand different confidence levels and error ranges. Procedures for obtaining peer review or evaluations of models and tools should be explored.

PLANNED NEXT STEPS

1. Dissemination of this report

This report will be provided to the workshop attendees and steering committee, and the Office of Science and Technology Policy (OSTP) as well as the ad hoc group of the National Science and Technology Council, and will also be disseminated to the broader materials science and engineering community by posting on the MaterialsInnovations@TMS Web site (http://materialsinnovation.tms.org/)

2. Formation of an ad hoc Intersociety Committee on MGI

TMS will convene a group of representatives from the professional societies that were represented at this strategic scoping session, in order to help coordinate the efforts of the societies to best support the MGI. This group will meet periodically to review, coordinate, and plan for future MGI efforts amongst the societies.

3. Smaller working groups

TMS will form and facilitate small working groups to address key topic areas that evolved from the MGI strategic scoping session. These groups can meet periodically to advance these discussions and identify paths forward.

Appendix: List of Attendees

MS&T '11 Materials Genome Initiative Strategic Scoping Session

Sponsoring Organization	First Name	Last Name	Affiliation	Title
ASM International	David	Furrer	Pratt & Whitney	Sr. Fellow Discipline Lead
ASM International	Jon	Tirpak	ATI	Executive Director, FDMC/Program Mgr
ASM International	Steven	Arnold	NASA Glenn Research Center	Chief Mechanics and Life Prediction Branch
ASM International	Terry	Wong	Pratt & Whitney Rocketdyne	Principle Engineer
ASM International	Scott	Henry	ASM International	Sr. Mgr., Content Development and Publishing
ASM International	Will	Marsden	Granta Design Ltd.	Product Director, Aerospace, Defense and Energy
ASM International	Teter	David	Los Alamos National Lab	Division Leader
ASM International	Thom	Passek	ASM International	Managing Director
American Society of Mechanical Engineers	Hussein	Zbib	Washington State University	Editor, Journal of Engineering Materials and Technology
American Society of Mechanical Engineers	David	McDowell	Georgia Institute of Technology	Regents' Professor
American Society of Mechanical Engineers	Mark	Horstemeyer	Mississippi State University	CAVS Chair Professor in Computational Solid Mechanics
American Society of Mechanical Engineers	Curtis	Taylor	University of Florida	ASME Center for Research & Tech Dev (CRTD) Nanomanufacturing Research Committee
SAE International	Tim	Mellon	SAE International	Director, Government Affairs
American Society for Civil Engineers-Engineering Mechanics Institute	Younane	Abousleiman	University of Oklahoma	Director, Poromechanics Institute
American Society for Civil Engineers-Engineering Mechanics Institute	George	Voyiadjis	Louisiana State University	Chair, Civil Engineering Dept. and Editor, Journal of Nanomechanics and Micromechanics

Sponsoring Organization	First Name	Last Name	Affiliation	Title
The National Assoc for Corrosion Engineers	Narasi	Sridhar	DNV	Director, DNVRI USA
The National Assoc for Corrosion Engineers	Rudy	Buchheit	Ohio State University	Department Chair
The National Assoc for Corrosion Engineers	Julio	Maldonado	Chevron Energy Technology	Sr. Research Engineer
The National Assoc for Corrosion Engineers	James	Dante	Southwest Research Institute	Mgr., Materials Eng. Dept.
American Ceramic Society	Marina	Pascucci	CeraNova Corp.	President & President, ACerS
American Ceramic Society	Jain	Vijay	URS NETL	Materials Science Manager
American Ceramic Society	David	Green	Penn State University	Professor & ACerS BoD
American Ceramic Society	Charlie	Spahr	American Ceramic Society	Executive Director
Materials Research Society	Todd	Osman	Materials Research Society	Executive Director
Materials Research Society	Bill	Hammetter	Sandia National Laboratory	Department Manager
American Chemical Society	Fritz	Walker	Air Products	Sr. Contracts Dev. Mgr. and ACS Presidential Roundtable on Sustainable Mfg.
American Chemical Society	Stewart	Mehlman	Praxair, Inc.	Director, Licensing, Alliances and Emerging Technologies
American Chemical Society	Richard	Love	American Chemical Society	Mgr., Programming & Technology
American Chemical Society	David	Lohse	ExxonMobil Research & Engineering	Councilor for the Division of Polymeric Materials: Science and Eng of ACS
American Chemical Society	Raymond	Garant	American Chemical Society	Asst. Director for Public Policy
Society for the Advancement of Material and Process	Mickey	McCabe	University of Dayton Research Institute	Vice President for Research, Executive Director, Research Institute
Association for Iron and Steel Technology	Kip	Findley	Colorado School of Mines	Assistant Professor
Association for Iron and Steel Technology	Amy	Clarke	Los Alamos National Laboratory	R&D Scientist
Association for Iron and Steel Technology	Daniel	Edelman	Nucor Steel - Indiana	UCS Devlopment Metallurgist

Sponsoring Organization	First Name	Last Name	Affiliation	Title
University Materials Council	Greg	Rohrer	Carnegie Mellon Univ	Professor and Dept. Head
University Materials Council	Chan	Helen	Lehigh University	Chair and New Jersey Zinc Professor
TMS	Paul	Mason	Thermo-calc Software	President
TMS	Chuck	Ward	U.S. Air Force Research Lab	Chief, Metals, Ceramics, NDE Div.
TMS	Li	Mei	Ford Motor Co.	Technical Expert
TMS	Neeraj	Thirmulai	ExxonMobil Development Co.	Materials Specialist
TMS	Charles	Kuehmann	Questek	President & CEO
TMS	Matthew	Zaluzec	Ford Research and Advanced Engineeriing	Senior Technical Leader
TMS	Warren	Garry	University of Alabama	Professor
TMS	Kevin	Hemker	Johns Hopkins University	Professor
MetSoc	Priti	Wanjara	Institute for Aerospace Research, National Research Council, Canada	Group Leader, Metallic Products Mfg.
Steering Group	Jim	Warren	National Institute of Standards and Technology (NIST)	Leader, Thermodynamics and Kinetics Group, Metallurgy Division
Steering Group	Julie	Christodoulou	Office of Naval Research	Director, Naval Materials Division
Steering Group	Dennis	Dimiduk	U.S. Air Force Research Lab	Principal Materials Research Engineer
Steering Group	McKnight	Steve	National Science Foundation	Director, Civil, Mechanical, Mfg Innovation Div
Office of Science and Technology Policy	Wadia	Cyrus	OSTP, Environment & Energy Division	Assistant Director, Clean Energy and Materials R&D