UMC Newsletter of the University Materials Council

Editor, Frank Wenzala, University of Wisconsin, Madison, WI
Telephone: 608-262-1821 - FAX: 608-262-8353

September, 1994

Thoughts from the Incoming Chair

Thanks for your show of confidence in giving me the helm of the UMC for the next year. It will be a challenge to maintain the course set by my predecessor, Jim Economy, but, as you'll see from reading this Newsletter, we have several interesting destinations on the horizon. Since we shall continue to navigate according to our accustomed tradition of shared governance, and since this column has a title that invites pontification, I submit the following "thoughts" for your valued consideration, prompted by a question:

How can the UMC best provide expertise, resources and assistance to our academic, governmental, and industrial decision-makers?

Most believe that we have the academic arena under control, but there are interesting new challenges here, too. As "materials" become the focus of many other academic departments on our campuses, we are faced with either defending our turf or supporting (maybe even submitting to) our competitors. What position should you (personally) take? How do you plead your case to the Dean, Provost, Chancellor? How can the UMC (collectively) help?

In Washington, the recent appointment of Jim Economy to the National Science Foundation's MPS Advisory Committee is gratifying news for all of us, and an excellent example of how the UMC might be tapped for service. Would you (personally) be willing to serve, if called? How do we (collectively) best represent the UMC to other agencies? to Congress? to the Executive Office?

Yes, we do provide industry with its best resource, our students, but are we efficient about responding to the changing needs of industry? How can the UMC sharpen the focus of the industry-university image?

Please accept my invitation to consider, debate, and amplify these questions over the next year, to challenge the scope of the UMC, to augment our responsiveness to national needs, and to return to our original mission: mapping directions for the nation. Of course, this means more hard work in the current economic climate. At the risk of over-extending my maritime metaphor begun in the first paragraph above, it seems that the wind has died, and our outboard tank is empty. It's time to go to oars and pull together...

See you in Boston.

Ron Gronsky

* *

UMC Winter Meeting

at Boston MRS Meeting

Tuesday, November 29, 1994
at the
St. Botolph Club
199 Commonwealth Avenue
Boston, MA

6:30-7:00 pm Cocktails
7:00-9:00 pm Dinner
PLAN TO ATTEND

* *

Note from the Editor - Frank Worzala

The 1994 UMC Spring Meeting had a different look than previous meetings in Washington, DC. Rather than a parade of agency representatives, our Chair, Jim Economy, invited a variety of speakers to address the major challenges of the materials community. A summary of the presentations is included in this newsletter. I'm sure you'll find them provocative, insightful and important.

One of the more intriguing ideas that evolved at the meeting was the initiation of a nationwide student contest in the materials area. As a means of enhancing the "visibility" of materials, this contest would mimic the Baja Car competition of the ME's and the Concrete Canoe race of the CE's. Jim Economy was encouraged by the group to investigate the possibilities of promoting a contest. With the help of Mert Flemings, the MRS was convinced that they should play a major role in such a promotion. The MRS board of directors will be considering the idea at the Winter meeting in Boston. We'll keep you posted!

In addition to presentations and the "contest" idea, several other topics were discussed at the UMC meeting. These included:

> The need for dissemination of results of the six NSF projects on Undergraduate Materials Education. A second workshop is being planned for the 1994 MRS Winter meeting in Boston. We should all be there or have a representative.
>
> The need for a yearly survey of job placement and job availability in the materials area.
>
> The need for additional funds for the UMC to pursue a more active role in promoting, among other things, the needs of the materials community in Washington. An increase in the annual dues to $100, from $50, was approved.

At the conclusion of the meeting in Washington, there was a general feeling in the group that the UMC was not being properly represented on the DMR Directorate Advisory Committee. Not one of the members was a current or past Materials Department Chair. It was felt that a chair could help articulate the concerns of the materials community. In a subsequent meeting with Bill Harris, this possibility was discussed by yours truly. Bill agreed that this was a good idea. The Executive Committee subsequently nominated Jim Economy and he was asked to serve on the MPS Advisory Committee. Starting this Fall, he will be one of 15 members on the committee. Congratulations, Jim!

Other points brought up by Bill Harris:

> All Directorates of the NSF are preparing Strategic Plans in consort with advisory committees. Important decisions must be made, since the budget for the next five years is projected to be nearly flat for research. Input from the materials committee is needed. "Its a zero-sum game", said Bill.
>
> The Mosaic computer system provides a good mechanism for communication. Comments, suggestions or complaints should be registered. Bill encourages a regular dialogue with the materials community on any issue of concern.
>
> Some of the questions being posed as part of strategic planning: Are there things being done that shouldn't be? Can we operate as well or better at less cost? Where are the new initiatives that will have big pay offs to the tax payer? What can we do to provide more high quality jobs for engineering and science grads? Bill would like our opinions and suggestions. Use the "Mosaic" lane of the electronic superhighway or simply use e-mail (WHARRIS@NSF.GOV).

Lastly, we have a dynamic new chair, as Ron Gronsky demonstrated in the opening column. Join us in Boston to help "crew" the UMC vessel.

Spring Meeting Summaries

Materials and the Environment
Jim Economy - University of Illinois

Problems associated with the environment are emerging as one of the most important issues facing society. Ground water contamination by industry, DOD, and from nuclear wastes represent extremely difficult problems which may require expenditures of $100's of billion dollars. In a similar way the solutions to problems associated with CO_2, NO_x, or SO_x emissions are equally daunting. These problems are further complicated by the tendency of the US Government to support R&D directed at quantifying the seriousness of these problems, and at the same time to legislate them out of existence.

There clearly are major opportunities for generating materials related solutions to these problems. The potential to design materials systems tailored for removing and recovering specific contaminants today appears very high. There has been considerable progress in understanding key features necessary for removing contaminants down to the range of ppb. For example, the role of pore size and shape in high surface area carbons is now better understood so that one can design the desired overlap potential within the pore for removing trace impurities. The ability to chemically tailor the pore surface chemistry to incorporate basic, acidic or highly polar groups permits a further degree of enhancement of adsorptions of specific molecules. Similarly, design of new kinds of chelating materials for use in ion exchange systems affords major opportunities for removing specific metallic contaminants from sludge. It should be apparent from this very brief discussion that major opportunities exist for design of advanced materials systems for removal and recovery of contaminants in the environment.

Redefining University-Industry Linkages
Tom Eagar - MIT

In the United States, there are dramatic changes occurring in universities, in industry and within the government. With the end of record enrollments brought about by the baby boom, and with changing governmental budgets, the universities face chromic unbalanced budgets. Fewer domestic students want a doctoral degree because traditional job prospects i.e. within other universities, national laboratories and centralized industrial laboratories, are not growing. Indeed, many are shrinking. The best students desire an education broader than traditional science and engineering, especially as they look to operations and product or process development as the path to future career growth. This makes it harder to place the doctoral students which the universities produce in the field of materials science and engineering.

Industry is faced with reduced research budgets and greater emphasis on shorter range product and process development. They are reducing the numbers of suppliers, even among the universities, but they are asking for closer, more focused relationships with the remaining universities. With declining defense budgets, people are rethinking the opportunities in high volume, commodity materials at the expense of the high-tech "boutique" materials. While there is less demand for doctoral students, there is rising demand for bachelor's and master's students.

The result is that industry needs the longer range (5 to 10 years) research of universities more than ever before. The potential resources to the universities out of this $120B industry budget are enormous, if the universities are willing to listen to their industrial customer. The goal must be to solve industry's problem, rather than to produce a thesis or a paper. Nonetheless, experience has shown that universities and industries can do all of these things, solve problems, produce theses and write papers, provided they are willing to adapt to each other. It is a lot of work, but it may be one of the only ways for universities to balance their budgets over the long run.

ABET Activities Update
Gerald L. Liedl - Purdue (TMS/EAC Liaison)

ABET accreditation activities are managed through the professional societies with TMS having lead responsibility for metallurgical/materials and NICE for ceramics. Coordination between these two societies has maintained a consistency throughout the field. Liaison with MRS was established in the past year and MRS now has an active committee with responsibilities in the area of accreditation. Informal liaison continues with ASM.

The 1992-93 EAC actions were the first to include the new interim visit/report. Outcome of the actions for last year show a shift to more NGR (Next General Review) actions than prior years as shown in the following table. There were 79 schools visited with 15 metallurgical/materials programs and no ceramics programs.

Summary of Engineering Accreditation Actions

Year (group)	NGR	I-V	I-R	SC	NA	Schools
1992 (all)	44	35	15	4	2	86
1993 (all)	67	17	14	1	1	79
1993 (met/mat)	10	1	3	1	0	15

Over the past couple of years there has been extensive dialog within the engineering community relative to policies and procedures of ABET. In response to these discussions ABET has been examining its operation. The EAC Winter Meeting held in January 1994 addressed some of these concerns and initiated actions to modify and/or change operations of the process. The Novel Program issue was addressed. Procedures are now in place for a program to request consideration of special exemptions. Lack of specific procedures had been a block in any action relative to a novel program. Other actions taken include:

Exit interview: Plans to leave information on deficiencies and ask for input within 30 days will be initiated next year. Hopes are to facilitate and speed the process by this and other actions.

Consultancy: EAC to ask professional societies to establish some procedures for providing advice and guidance. ABET would then refer requests to the societies. TMS in process of establishing a procedure and policies for providing help in this area.

Evaluator Assignment: EAC will allow societies to make evaluator assignments with team chair having veto rights. Belief is that societies can better match program and evaluator. TMS has a process established to accomplish this effort.

Evaluator Training: Training to be mandated with periodic reviews. Observer status recommended prior to visit . Will require societies to review evaluator performance and provide feed back to evaluators. Inputs from team chair, institution, and report review will be used by TMS.

Criteria: A full review is underway with an emphasis on separation of MUSTS from SHOULDS.
Once general criteria are reviewed, there will be a sunset placed upon all current program criteria Societies will be asked to submit a new set based upon general criteria and program needs.

A series of consensus workshops are being held with people from all avenues being asked to participate. Three are planned: criteria, participation, and process.

New Generation of Vehicles -- A Materials Challenge
Norman A. Gjorstein - Director, Materials Research Laboratory, Ford Motor Company

The application of alternative materials to automotive vehicles has taken place at an accelerating pace over the past two decades and has been a prominent factor in the American auto industry regaining its competitiveness, and in meeting societal and regulatory needs. These forces will continue to drive the use of alternative materials in the future.

The auto industry has been an enormous consumer of materials -- some 23 million tons of materials annually, including steel, cast iron, aluminum, plastics, etc. Put another way, the auto industry consumes 14% of the U.S. production of steel, 16% of aluminum, 10% of copper, 23% of zinc, 68% of lead 60% of cast iron, 34% of platinum and 50% of rubber. Yet, when the vehicle is finally assembled, the finished value of the vehicle is only about $4 per pound. And the dominant material, steel, costs only 38 cents a pound!

The strongest pressures for technological change will come from the need to deal with the impact of our products and manufacturing processes on the global environment and the need to conserve material and energy resources in the future. These pressures are already being felt. For example, there is general concern in the U.S. over our growing usage of imported oil, which has risen from 23.3% in 1970 to 45.5% in 1991. Moreover, about 65% of the total U.S. consumption of petroleum is related to transportation, the bulk (97%) of which is utilized in highway (cars, trucks, buses) transportation. Another more recent concern has to do with the rise in CO_2 production, and the perception by some that this may lead to adverse global climate changes. These concerns have resulted in growing pressures to improve the fuel economy of highway vehicles.

The requirements that control the implementation of new materials in the auto industry are: low cost in fabricated form; and capability to produce components and assemblies in high production volumes, while maintaining very high reliability. In the past, regulations have forced the introduction of new technologies: lightweight materials, catalysts, electronic controls are good examples. Environmental and resource issues will continue to dominate our strategies for the future: increased use of lightweight body structures and many other lightweight components; FRP and aluminum will compete with steel as the primary body material; recyclability of material candidates will become increasingly more important; aluminum may be favored unless recycling technologies can be developed for composites; and electric and alternate fuel vehicles may be deployed in special situations, together with lightweight structures.

Copies of Norm's paper can be requested. His address is Ford Motor Co., M.D. 2247, P.O. Box 2053, Dearborn, MI 48124.

The Role of Materials Research in a Changing World
Bob Reynik - NSF

Copies of the overheads used by Bob were transmitted to all of us, shortly after the meeting. To highlight the message being conveyed, the major points put forth are listed below.

Advanced Materials are vital to national priorities.
Maintain a balanced federal program in basic and strategic materials research.
Continue to develop a coherent NSF program in Advanced Materials.
Develop research and training partnerships with other federal agencies, national laboratories, state governments, and industry.
Integrate research and education providing future scientists and engineers with a flexible background.
Organize national workshops to promote partnerships and define broad priorities.
Develop ways to measure progress and "prove" contributions to national goals.

New Themes for MS&E Departments (Year 2000)
Richard Tressler - Penn State

Dick Tressler, Penn State, led off this discussion followed by brief presentations by Tom Courtney, Michigan Tech, Nick Eror, Pitt, and Slade Cargill, Columbia. Tressler's comments are summarized here.

Four clear directions are emerging for our field in the next decade.

The Materials Science and Engineering "customer"-discipline interface must become stronger. Our research sponsors are insisting on more applications oriented research and relevance to engineering systems which implies a better integration with the relevant engineering discipline. Employees of our students expect them to be familiar with devices and complex systems. The integration of MatS&E with electrical engineering is quite well integrated now and may be a model for interactions with other engineering fields such as mechanical, chemical, civil, and aerospace. Two emerging fields deserve special attention in this regard - manufacturing engineering where our expertise as needed, and bioengineering where benign materials must be invented and certified.

Environmental issues will dictate the choice of materials to synthesize, fabricate, and use in the future. Recyclability and the whole life cycle impact of materials will become key societal issues with which our field must learn to deal. Our departments must integrate these concepts into the educational process either by developing special courses or integrating this material into existing courses.

Teamwork among engineers is a way of life in

industry today. We must develop a new model for our senior projects or capstone design courses (Tom Courtney presented Michigan Tech's approach to teamwork in their senior design course). Integration of students from other disciplines into these team projects is deemed very desirable by the employees of our students. Do we need faculty with joint appointments to be successful in this regard?

The integration of science disciplines into our enterprise is probably the easiest of the four directions to achieve. In fact, at many of our universities, MS&E Departments are highly science oriented. Are the fads of "materials chemistry" and "materials physics" going to eclipse MS&E departments and siphon off funds that would otherwise be appropriated to MS&E departments? As a field we must continue to assert ourselves at the integrators of basic materials research inputs to achieve practical engineering solutions to society's needs.

Improving the Job Potential for MS&E Grads
Reza Abbaschian - Florida

All engineering disciplines were faced with declining entry-level job opportunities during the last few years as industries were either "down-sizing" or shifting from long term R&D to more product related activities and manufacturing. For materials science and engineering graduates, the situation was generally no different, and recruitment by the so-called "traditional" employers declined. However, this decline was partially compensated by an increase in the number of new "non-traditional" employers. The latter employers span the whole spectrum, from large to small companies, from chemicals industries to biomedical, consulting, etc. The diversity of the companies was exemplified by the listing of the employers of recent graduates of the Materials Science and Engineering department of the University of Florida. The starting salary range for BS graduates was from $32K to $40K.

The diversification of the employers seems to have benefited programs which offer a broad-based materials education more than those which offer specialized training in one class of materials. The employers, traditional or non-traditional, generally expect MS&E graduates to have broad-based training in materials - manufacturing - sales - management issues. They also prefer to hire graduates who had co-op or other practical training.

A recent survey of the alumni of the MS&E department at the University of Florida showed that among 137 respondents, 85% were working in R&D, manufacturing and engineering design, with the remaining were in marketing and sales, supervision, graduate studies or not related to engineering. They overwhelmingly indicated their jobs to be directly related to their MS&E education, regardless of the nature of the company. In response to the question "Is the job you are doing now related to your MS&E education"?, 49% responded yes, definitely, 33% yes, somewhat, 11% no, not very much, and 7% no, not at all.

The placement of the fresh graduates was mostly through departmental contact (22%) and placement office (19%), followed by networking (16%), and company personnel departments (10%). Placement through employment agencies accounted for only 1% of the hiring. In contrast, for the subsequent positions, networking through professional acquaintances accounted for 43% of the job placement, with other sources accounting for 10% or less each.

The diversification of the employers will most likely continue in the near future. As such, the job opportunities for broad-based materials science and engineering will most likely remain relatively good. The major challenge is to provide such an education within the normal 4 year college curriculum. Combined MS and BS degree might be an option, provided that employers recognize such degree holders above current engineers and pay them accordingly.