Conference on Advanced Materials Considers "The Washington Side of the Equation"

On October 10-11, 1989, in Washington DC, an audience of about 40 people heard a series of government officials describe their programs at a conference entitled "Advanced Materials: The Washington Side of the Equation." The conference was sponsored by The Wilson Reports, and conducted by Robert Wilson, former director of the National Critical Materials Council.

Because some advanced materials markets are growing at 30% per year, Wilson perceived the need to provide an opportunity "to get acquainted with key national players in the advanced materials arena." He assembled most of them into this two-day series of presentations. Both Congress and the executive branch of government were represented, as were the heads of several private sector interest groups.

The conference focused on describing the newly evolving policy towards advanced materials, and the research agenda that will implement it. Congressmen Tim Valentine (D-NC) and Don Ritter (R-PA) spoke on consecutive days, each emphasizing the role of advanced materials as a key to new technological products. Both noted that synthesis and processing are the points where the United States is weakest relative to foreign competitors.

Valentine described the formation and goals of the "Materials Caucus" in Congress, a group of Congressmen and Senators who share a common interest in materials questions. The caucus spans liberals and conservatives, industrial and agricultural districts, etc., which reflects the bipartisan, national nature of the advanced materials issue. Valentine called on the attendees to develop a consensus and help set priorities, but he also emphasized that advanced materials competes with other programs for limited government money. "All you folks here today are leaders in your community," he said. "You can serve your interests if you will help educate the American people to understand that we shouldn't spend more and send the bill to our children and grandchildren."

Ritter observed that although the United States spends $1.6 billion annually on materials research, it is lagging in the synthesis, processing and manufacturing areas. U.S. university facilities are dated, as are many of its factories. By contrast, he pointed out, MITI in Japan has always focused on the processes that lead to mass-scale manufacturing technology. After adjustment for inflation, involvement of the U.S. federal government in materials research has declined 21% in recent years, and is flat this year. Ritter stated that basic research is done well in the U.S., but for four decades processing and manufacturing science have been ignored. Today, he said, we are able to explain what happened, but we haven't fixed it yet. To underscore the dichotomy between basic and manufacturing research, Ritter said: "Sure, we own the 'cutting edge,' but where is the rest of the blade? Somebody can pick your 'cutting edge' off the scientific journals and incorporate it into their technology."

Ritter also stressed the importance of developing a "constituency focus" on the role of materials. Materials are everywhere, and therefore lack the out-front constituency that supports the space station, the SSC, etc. As did Valentine, he called on conference attendees to dive in and participate. "You are in the race," he said. "The way you get results is to convince Congressmen that their constituency is affected by materials issues. Then you'll make the materials caucus successful."

In an extended question-and-answer period, Ritter responded to a wide range of inquiries concerning, among other things, the National Critical Materials Council, a "civilian DARPA," investment tax credits, and Sematech. It was clear that having this materials scientist (PhD, MIT, 1963) in Congress is a great asset in building a coherent national program for advanced materials.

From the Congressional Office of Technology Assessment, Greg Eyring recalled themes from recent OTA reports in materials science: they see an increasing "military" role in advanced materials; they do not believe that consortia can be a panacea for U.S. competitiveness. The real measure of a company's interest is how much it will spend of its own money.

OTA is also attentive to other issues, such as environmental and health concerns, the deterioration of bridges and sewers, and archaic regulations that are barriers to new materials. Eyring sees three things OTA can do for advanced materials policy: monitor industry concerns, be a source of information, and serve as a broker to resolve civilian/military conflicts. He felt that the multidisciplinary research institutes at the national laboratories, notably the superconductivity pilot centers, are good examples of productive industry-government collaboration.

In addition to covering the policy direction provided by Congress, the conference also educated its attendees in the programs of most of the government agencies active in materials research. Alan Dunn gave an overview of the Commerce Department's role, reminding the audience that Commerce is industry's representative to the government. Joe Caponio described the National Technical Information Service, which not only publishes government documents but promotes licensing of government-owned patents as well. Dan Mulville summarized NASA's interests in materials for aeronautic applications, especially in composites and special fibers. (In deep-space missions, it will be necessary for certain materials to perform well for longer time periods than they have been in existence.) Iran Thomas presented the numbers for the Department of Energy's materials science program of basic research.

Al Schindler outlined activities supported by the National Science Foundation's Division of Materials Research, stressing the importance of industrial collaboration with the universities doing this work. He indicated that a number of NSF-supported science and technology centers are expected to phase in considerable industrial support in the next few years. Moreover, co-funding by industry always makes a proposal to NSF look more attractive. NSF is placing particular emphasis on undergraduate activities in order to make materials research more attractive to undergraduates. Schindler recounted how the great advances in computational modeling in recent years (dendritic growth, crack propagation, etc.) have influenced many different areas of materials research.

Presenting the military perspective, Ben Wilcox of the Defense Advanced Research Projects Agency (DARPA) described the biggest government program in materials research (approximately $140 million). DARPA issues "broad agency announcements" of research opportunities in certain areas, and then entertains proposals that come in. The agency is beginning to focus on research directed toward lowering manufacturing costs, under the label "intelligent processing," since DARPA has found that, in the past, no one but the military could afford some of their developed technologies. "Dual-use technology" is on DARPA's mind today.

Wilcox punctuated his talk with technical examples, a welcome diversion from the program-and-policy flavor of the overall conference. He described, among other things, the new Lanxide process for direct oxidation of molten metals into ceramics and the strategy of interrupting crack propagation by reinforcing ceramics with fibers. Because there is great public interest in high temperature superconductivity

https://doi.org/10.1557/S0883769400060905 Published online by Cambridge University Press

(HTSC), Wilcox gave some details of the progress in DARPA's program. He explained that DARPA contractors can routinely make thin films with good properties, that they have demonstrated a prototype HTSC SQUID, and that they expect to have HTSC passive coatings for microwave devices.

Robert Pohanka covered the materials program of the Office of Naval Research (ONR), an agency which collaborates closely with DARPA and others. With three broad categories of interest (structural materials, materials interfaces and functional materials), ONR has selected certain topics for emphasis in the near term. For example, in FY 92, extra attention will go to processing of composites, welding, and ferroelectric thin films. ONR funds university research (which falls in the 6.1 category), in contrast to its sister agency the Office of Naval Technology, which funds 6.2 work at Navy laboratories.

The featured luncheon speaker was Klaus Zwilsky of the National Academy of Science's Materials Research Board, whose report, *Materials Science and Engineering for the 1990s*, was released 10 days earlier. Zwilsky framed his review of the report in terms of seven questions: How did the report come about? Who wrote it? What does it cover? What are the findings of the report? What does it recommend? What will happen now? Should I buy a copy for $39.95? This format kept the audience alert after lunch—always a challenging goal. (Editor's Note: For a synopsis of the MS&E Study report and comments offered during its unveiling at the Solid State Sciences Committee forum, see p. 27-32 in the October 1989 *MRS BULLETIN*.)

The National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) was well represented by Lyle Schwartz, who gave the only presentation at the conference that contained major technical content. After reviewing the NIST budget and planning for the Advanced Technology Development Program—a possible form of a "civilian DARPA"—Schwartz reviewed several examples of NIST's interaction with industry: an aluminum extrusion temperature sensor, an on-line texture control system using neutrons and electromagnetic acoustic transducers, and a method of forming metal powder using a large atomizer. The latter was particularly illustrative of a sound industrial collaboration. Three industrial partners will each take away the basic understanding gained with the NIST atomizer orifice geometry and develop their own specialized commercial versions.

The question period elicited much discussion of where the boundary line is between pre-competitive R&D and commercialization. Schwartz stated that "the players have to recognize the competition from abroad and go back home and decide to give something up in order to survive." He felt that the biggest advantage gained by industrial collaborators is advanced notice, where they have at least six months lead time over their competitors.

The final session of the conference assembled the heads of certain interest groups to comment on these government programs. Glenn Cullen, speaking for the Federation of Materials Societies, approved, supported and expanded upon the Academy report with his presentation. John Hall, Chairman of SACMA (Suppliers of Advanced Composite Materials Association), described three major points of interest to them: materials qualifications methods, worker health and safety, and a new polyacrylonitrile-based carbon fiber. Mark Newkirk of the U.S. Advanced Ceramics Association summarized their perception of the progress of recent ceramics research, and recommended government action that would bridge some gaps, in part by supporting demonstration programs.

The final speaker was Kevin Ott of the Council on Superconductivity for American Competitiveness (CSAC), who described their involvement with the "superchip corporation," a CSAC spinoff that hopes to incorporate HTSC components on electronic circuit chips. Having monitored Japanese progress in HTSC through ISTEC for two years, Ott warned his listeners that the competitive threat was extremely grave. CSAC also intends to deliver to DARPA a "U.S. master plan" for high temperature superconductivity next October.

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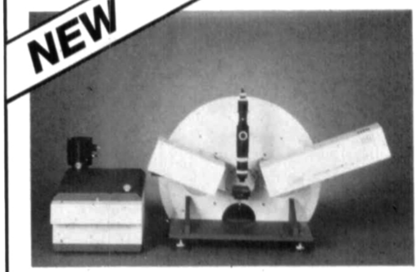

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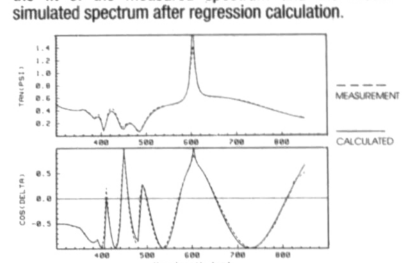

A cross comparison between Spectroscopic Ellipsometry and X-TEM gives very good agreement and show a better resolution of the multilayer structure.

Materials	S.E. Thickness in nm	X-TEM Thickness in nm
SiO_2	2.5	2.5
Si	96.6	95.1
SiO_2	388.5	419
$SiO_2 + Si_{(30/70)}$	19.5	
$SiO_2 + Si_{(60/40)}$	9.0	
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https://doi.org/10.1557/S0883769400060905 Published online by Cambridge University Press