CSAC Tech Transfer Meeting Considers Government Support, National Commission Superconductivity Report

On September 14 in Washington, DC, the Council on Superconductivity for American Competitiveness (CSAC) held its second annual meeting concerning the transfer of the revitalized technology of superconductivity to the marketplace. This year's meeting was entitled, "Superconductivity: Programs, Politics and Products."

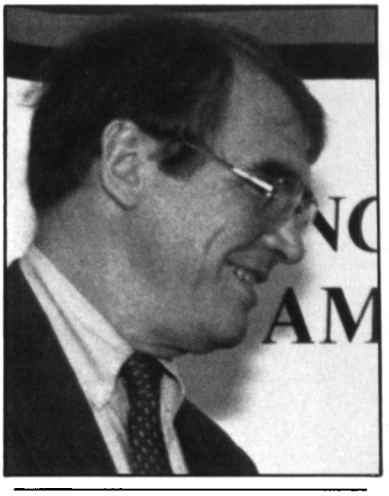
CSAC was formed during the flurry of activity surrounding the discovery of the new high-temperature ceramic superconductors more than three years ago. It is the creation of its current chairman, George Keyworth II, former science adviser to President Reagan and now director of research at the Hudson Institute. CSAC board members have been drawn from a broad spectrum of U.S. high-tech institutions.

Since its formation, CSAC has lobbied for strong support of R&D on the new superconducting materials and has focused on two particular initiatives—introducing high Tc superconductors into microelectronics through a government-supported "SuperChip" consortium, and developing magnetically levitated vehicles, which CSAC labels as its Maglev 2000 project.

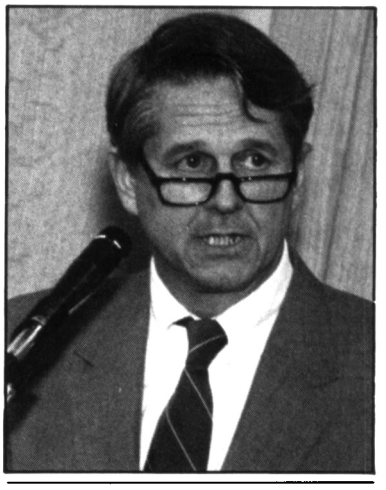
This year's meeting included the topic of government support. Attendees heard from representatives of the Departments of Defense, Energy, Commerce, and Transportation, and also from speakers knowledgeable on the various government reports that have emerged. Speakers covered reports from the Office of Technology Assessment, Office of Science and Technology Policy (Five-Year Action Plan), Japan Technical Evaluation Committee (JTEC), and the National Commission on Superconductivity. Commercialization prospects in the fields of electronics, maglev vehicles, electric power devices, and imaging were also discussed.

In introductory remarks, Keyworth set the tone by highlighting what he considers to be vexing problems: "government virtually paralyzed by fear of industrial policy-...large DARPA funds, only to see them go to large consortia rather than small business..and DOE pilot center funds being redirected to nonsuperconducting areas." He said it is "sobering to realize that Japan is making double the investment in superconductivity than the United States." Keyworth suggested that "it is critical to focus on some ambitious goals, with a pervasive number of applications—choices must be made." Voicing support for high-speed computers (in the petaflop regime) and magnets and wires for power generation, SMES, and maglev, Keyworth said that "industry-led, government-supported R&D is absolutely essential."

In a subsequent talk, Frank Patten of DARPA countered by asserting that



"Industry-led, government-supported R&D is absolutely essential," says CSAC Chairman George A. Keyworth.



Robert M. White, the U.S. Commerce Department Under Secretary for Technology, explains the Commerce Department's views on U.S. technological competitiveness. See "Material Matters" in this issue for the text of White's comments.

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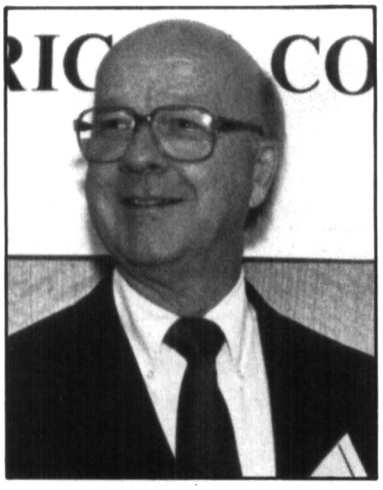

David W. McCall, chairman of the National Commission on Superconductivity, describes the Commission's report.

DARPA "does support some small firms that need to make it in the short run," citing Superconductor Technologies, Inc. of Santa Barbara as an example. Patten did say, however, that DARPA "would not be supporting new things in the bulk area because they don't have as big a payoff to DOD," lending some credence to Keyworth's claim that industrial policy is no longer in vogue at DOD.

Two highlights of the meeting were the appearance of the long-awaited report of the National Commission on Superconductivity, and a keynote luncheon address from the Commerce Department's Under Secretary for Technology, Robert M. White. White's remarks are published in the "Material Matters" department in this issue of the *MRS BULLETIN*.

The National Commission on Superconductivity was created by the Omnibus Trade and Competitiveness Act of 1988 for the purpose of producing its report, and the Commission officially terminated on August 7, 1990, the date appearing on the report. The Commission chairman, David W. McCall of AT&T Bell Labs, described the report to attendees at the CSAC meeting. One of the report's recommendations is that a body, not unlike the Commission itself, be created as a standing committee to continually assess the field.

The report's executive summary is reproduced below. Copies of the full *Report of the National Commission on Superconductivity* are available from: National Critical Materials Council, Executive Office of the President, Room 5002, New Executive Office Bldg., 725 17th Street NW, Washington, DC 20506; telephone (202) 395-7200.

Report of the National Commission on Superconductivity

Executive Summary

Recent scientific and technical progress in oxide superconductors brings the revolutionary promises for commercialization of these materials closer to reality. However, the road to widespread applications remains long and arduous. The United States must make a sustained, concerted effort to compete effectively for potential markets and to realize the enormous opportunities offered by the discovery of the materials.

First and foremost is the need to develop an industrial technology base and a manufacturing capability for superconductor technology and products. The investment and participation of U.S. industry in superconductivity research and development is insufficient, especially compared to the situation in Japan, where industrial R&D is twice as large, making the Japanese better able to take advantage of innovative research and to develop products for the marketplace. To a large extent, a disadvantageous business environment in the United States, rooted in high interest rates, unfavorable tax policy, antiquated antitrust laws, and other factors, discourages U.S. industry from investing in high-risk technologies such as superconductivity.

Until structural repairs are made to improve the business environment, the resulting disadvantage can be offset by leveraging industry's investment with federal R&D funds to build a level playing field for U.S. industry. The Commission supports the efforts of the Defense Advanced Research Projects Agency (DARPA) to develop superconductor technologies and insert these in U.S. industry because of the convincing advantage that superconductors provide for military requirements and the beneficial spinoff they will have on the commercial sector.

Better mechanisms must be developed to realize the potential of superconductors for commercial applications. The Department of Energy Superconductivity Pilot Center programs at three of its laboratories appear to be a very effective mechanism to

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engage U.S. industry in cost-shared, collaborative R&D. Industry-led consortia (or alliances) are beginning to pool the resources of U.S. industry and leverage them with university and federal laboratory research. These mechanisms should all be strengthened and others, such as the new Advanced Technology Program initiative of the Department of Commerce, should be encouraged.

To provide impetus and focus to the U.S. effort to commercialize superconductor technology, the Commission recommends setting two ambitious goals for these collaborative R&D programs: an ultrahighspeed computer, and a prototype, high-temperature superconductor wire and magnet project.

The intrinsic advantage of high processing speed and low power dissipation of superconductors combined with continued advances in massively parallel computer architecture opens the possibility of reaching the petaflop computer regime—a millionfold improvement over today's technology.[1] There are several defense requirements for such computing speed—including realtime image and information processing, cryptography, and anti-submarine target identification—that should justify defense support for the long-term goal of petaflop computing. Novel applications in the commercial sector, such as improved global climate modeling, weather forecasting, and aerodynamic aircraft design, will follow. In addition, the advances required in thin-film synthesis and superconducting digital electronics necessary for petaflop computing will stimulate innovation in U.S. commercial electronics and computer industries.

A concerted national effort is required to develop high-temperature superconducting wire suitable for magnets, motors, generators, energy storage systems, and transmission lines. This will require a research and technology development effort beyond the scope of universities or individual companies. The enormous potential improvements of such devices in energy efficiency leads us to suggest a lead role for the Department of Energy laboratories in developing generic, but commercially useful, superconducting wire and prototype magnets. The Department will have to collaborate closely with universities to incorporate the latest scientific innovations and with industry to assure commercialization potential. Such an effort will also be very beneficial to defense applications where magnets, motors, generators, and electric propulsion could be improved significantly by superconductors.

Next to encouraging greater industry participation in superconductivity R&D, the Commission strongly recommends increased support for university research scientists and engineers. Although we are encouraged by recent technical progress, it is clear that continued innovation and scientific breakthroughs will be required to achieve the full potential of the new superconductors. It has been demonstrated repeatedly that these are most likely to originate from individual researchers or small groups of researchers at universities, federal laboratories, or industrial laboratories. The history of superconductivity supports this contention. Support for university research is also important because it provides the talent for tomorrow's technologies.

The Commission recommends establishment of a standing oversight group that will generate sound information on progress in superconductivity. This group would report to the President's Science Adviser and the Office of Science and Technology Policy (OSTP) on the effectiveness of research being supported by the various agencies, on the effectiveness of mechanisms for coupling government R&D investments and U.S. industrial activity, on the establishment of research priorities, and on gaps in technical programs.

The Commission suggests the creation of an international committee to enhance planning and cooperation among the programs of the various nations. This group is not to be confused with the standing oversight group recommended above.

The Commission proposes that the National Science Foundation, with the cooperation of industry and other government agencies, should increase support for science education in the early grades and on through college. This is vitally important for maintaining the Nation's supply of scientists, engineers, and mathematicians. Superconductivity, with its public appeal, should be a useful subject for stimulation of student interest in these fields.

1. The speed of a computer is measured in terms of the number of floating point numerical operations (flops) it can carry out per second. Today, 10^9 operations per second, a gigaflop, is fast. A petaflop is 10^{15} operations per second. Massively parallel system architecture will be required to build a petaflop machine. The role of superconductivity would be to enhance the performance of individual processors.

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USACA Outlines Advanced Ceramics Commercialization Plan

Explaining that the 1990s are ushering in a new "Age of Materials," the United States Advanced Ceramics Association (USACA) publicly unveiled a six-point advanced ceramics development and commercialization plan on October 2, 1990. As perhaps the first salvo toward increasing the promised visibility for advanced materials in 1991, the plan comes at least partly at the behest of the Congressional Caucus for Advanced Materials. It is intended to launch a dialogue with administration and congressional leaders consistent with the administration's pledge to give the advanced materials a major spotlight in 1991.

Titled the "Bridging the Gap Initiative," and having taken two years to pull together, the proposal's main purpose is to decrease the time from laboratory to product for advanced ceramics. USACA officials say that time is now a decade or longer in the United States. There are severe problems in attempting to narrow the gap, including the need for an enormous investment of capital, which is currently at a very high premium in America. There are also few incentives to help accelerate the use of ceramics or to invest more money in research, according to USACA.

For example, USACA calculated that typical aerospace contractors generate a dollar's worth of sales for every 50 cents invested. However, it takes advanced materials manufacturers two to four dollars of investment to generate one dollar of sale, according to USACA President-Elect Maxine Savitz.

"Faced with this daunting array of obstacles, industry has had a difficult time justifying the huge expenditures necessary," says Savitz. "And yet failure to make these investments essentially means abandoning the field to our overseas competition."

Representatives of the 37-member group estimate that the incentives will cost from $250 to $300 million over the next decade if fully implemented—not particularly good news in a time of budget cutbacks. But Executive Director Steve Hellam, in paraphrasing Eldridge Cleaver, noted that, "We are not one of the problems, we are one of the solutions."

If the incentives are successfully implemented, USACA officials see a major advanced ceramics program in the United States by the year 2000. They anticipate

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there will be 39,000 employees, compared to the 6,000 now working in the field. While USACA Board Chairman Bernard Meyer, who is executive vice president of the Norton Company, characterized most advanced ceramics activity as currently at the pilot stage, he and other officials there believe ceramic components will begin making their way into U.S. automobiles and trucks in the next two years.

USACA reinforced its support of current federal efforts, including those already existing at the Departments of Defense, Energy, and Commerce. "We applaud these efforts, and think their successes justify additional programs," said Savitz. "For example, it would be valuable to demonstrate ceramic gas-turbine engines and other ceramic components in automobiles and trucks and in aerospace applications." At the Defense Advanced Research Projects Agency, USACA is backing an insertion program whose purpose is to demonstrate advanced ceramics components in military systems.

Many private firms have good ideas that the government needs but hesitate to work with the government because they fear their ideas will be declared subject inventions, Savitz found. She noted that the government may indeed be cutting itself off from technologies critical to its needs.

USACA defines advanced ceramics as including a wide range of inorganic, nonmetallic materials "produced by new technologies." Advanced ceramics differ from conventional ceramic consumer goods, such as dinnerware and tiles, because of their greatly improved properties, the novelty of the processes used to produce them, and their applications. They are considered to have superior wear resistance, resistance to chemicals and high temperatures, and dimensional stability, and strength-to-weight ratios three times higher than metals. They are used in aerospace, environmental protection, automobile, defense, and electronics applications and even in bioceramics for artificial bone and teeth implants.

Robert Post Represents MRS in New Public Affairs Office

Robert L. Post, who recently completed his tenure with the White House Office of Science and Technology Policy (OSTP) and his position as executive director of the National Critical Materials Council, has been devoting a portion of his time for the fall quarter to the MRS Office of Public Affairs in Washington, DC. Post joined the OSTP under the Reagan administration and helped with the transition after the 1988 election. He has had broad experience with the materials-related activities of that office in addition to experience with the funding of materials and other technical fields at the Office of Management and Budget.

Post holds a PhD in geology from the University of California at Los Angeles and an MBA from Harvard University. After serving in the armed forces, he has been primarily associated with the governmental side of science and science policy.

Through the *MRS BULLETIN*, Post will keep MRS members informed of materials-related activities in Washington. He will also brief MRS officers on matters of concern to the Society on the Washington scene, as well as field government and press requests for information about MRS and materials science and engineering in general.

Post's efforts will also support the upcoming Washington Materials Forum, February 28-March 1, 1991, sponsored by MRS and several other societies. The forum will follow the Solid State Sciences Committee meeting on February 27 at the National Academy of Sciences, and will include a report on the Materials Science and Engineering Study's Regional Meetings. Post was instrumental in initiating the Regional Meetings and has participated in the process to this point. MRS looks forward to his assistance in spotlighting for science policymakers the importance of materials and of MRS's role in the materials community, and in providing for MRS members a clearer window on materials-related activities in Washington.

MRS Office of Public Affairs
Washington, DC

USACA's "Bridging the Gap Initiative" for Advanced Ceramics

Point One: Create multiyear federal ceramic component demonstration programs that will support the domestic development, manufacture, purchase and in-use demonstration of advanced ceramic components and parts over a five-year period. They would target both civilian and military programs, including automotive, aerospace structural, aerospace propulsion, electronics, machine tools, additional weapons systems, component applications, and industrial process equipment.

Point Two: Create Defense Production Act Title III advanced ceramics programs. These programs would take the form of purchase commitments (guarantees) to buy ceramic components produced by domestic advanced ceramics manufacturers for incorporation into various military systems.

Point Three: Create and expand investments in domestic advanced ceramics manufacturing science and technology programs aimed at demonstrating cost-effective production and reproducibility of advanced ceramic components focused on specific requirements of end-users.

Point Four: Recognize the capital intensive nature of the advanced ceramics industry and promote industrialization in this area by allowing a more competitive return on advanced ceramic components purchased through the federal procurement system and by permitting first-year write-down of those new capital investments made by the advanced ceramics industry during a 10-year period.

Point Five: Provide tax incentives, such as government-funded rebates, for domestic advanced ceramic end-users who incorporate advanced ceramic components in products and demonstration programs during the next decade, so as to provide user "pull through" to the U.S. advanced ceramics industry.

Point Six: Mandate the vesting of technology rights in advanced ceramics to domestic advanced ceramic manufacturing contractors when they participate in R&D, man-tech and demonstration programs on a cost-shared basis, in order to attract and promote the most commercially attractive and innovative technologies in these efforts.

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