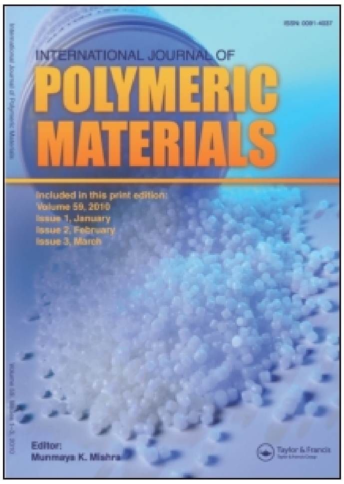


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# Foreword

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# Foreword

## RATIONALE FOR THE EVENT

This event honors the materials engineers and scientists who have made the most significant contributions to technology and to society through their research and inventions. It is very appropriate that such a meeting be organized by the National Association for Science, Technology and Society (NASTS), which focuses on how science and technology affect society. Furthermore, the cooperation with the Federation of Materials Societies assures the widest possible base for input from the world of contemporary materials research and education.

It is not only NASTS, but a very large segment of the materials research community, that believes those scientists who have succeeded in such relevant-to-society research are never adequately recognized. Several forces conspire to cause this otherwise unintelligible distortion. First, the general media, and increasingly major scientific journals themselves which publish "news" as well as technical articles, tend to publicize on the weekly basis of their publication schedule, some "breakthrough" however ephemeral it may be. Second, there is frequently a personal angle to the "story." Third, real societally-impacting advances are complex processes invariably involving several persons, often from different organizations, which take typically 10 to 15 years to "mature." Hence the medias' self-chosen processes filter out virtually all successful, societally-impacting research. Mao's "1000 flowers" may bloom in the first week of May, but we know that of these perhaps one or two will grow into a tree which bears fruit in 10 or 15 years.

This distortion of scientific research has very serious consequences for several different communities.

a. Among national science and technology policy makers, in both the public and private sectors, a distorted picture of various science fields emerges, made up of collages of "breakthroughs," none of which may ever have any impact on society or science.
b. Within the scientific community itself, which already distorts its own behavior to respond to incentives on exaggerated claims or breakthroughs. This perpetuates the error throughout the values of academics and students.
c. And within the self concept of science as enunciated by its leaders. Certainly Einstein's words fit much more closely with what we are articulating here than what goes on in a typical scientific society meeting.

"It is not enough that you should understand about applied science in order that your work may increase man's blessings. Concern for man himself and his fate must always form the chief interest of all technical endeavors, concern for the great unsolved problems of the organization of labor and the distribution of goods—in order that the creations of our minds shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations."

This attempt at changing back the values of the science community is very timely because there has been a massive unremarked change in the society that supports science.

## THE NATIONAL SETTING FOR RESEARCH TODAY

The socio-economic context in which materials development will be done in the foreseeable future will be radically different from the one in which all the speakers and most of the audience were brought up, for a number of reasons.

First, the beginning and end of the Golden Age of Science can be dated and marked, albeit approximately, from July 18, 1945 (Alamogordo, A-bomb test), to October 21, 1993 (Washington, DC, defeat of the Superconducting Supercollider). The passage of that era has profound consequences for all science and engineering, including, of course, materials. The concept that science-push can lead to new products and subsequently new markets has been weighed in the balance of industrial experience and found wanting. In only very few cases have really new materials led to new markets. Today, the time constraints of product development and available patient capital have diverged further; materials very rarely drive systems. Systems pulled out, by demand, those new materials that actually made it into the marketplace. For the materials community it means that in the future, materials will be "on tap, not on top."

The second major historical reality is that industry has abandoned longish-term untargeted research and is even cutting back on long-term (5–10 year) research in its own product areas. In a "globalized" R/D system, this is unlikely to change.

A third major element of the new situation is the worldwide glut in many major materials products from aluminum ingot to diamond grit. And a final major change is the surplus of technical personnel eliminating any national comparative advantage in education. The materials development cycle I foresee is the "Technology Traction" model (1), where existing core business technologies, pulled by (new) markets, will continually move to retain or increase market share in turn drawing on the three kinds of science: serendipitous discovery from worldwide sources, targeted research and "on-the-shelf" basic science (1). The era of the ascendancy of the science-push concept—a concept never validated—has drawn to a close.

## A HISTORICAL LOOK AT POST WW II MATERIALS RESEARCH

The burst of activity in American science after WW II included, of course, a surge in the materials field, reflected in the glory days of GE's R&D Center and the grand research meccas of Bell Labs, Dupont, IBM, and so forth. However, in retrospect, included in such labs was a curious mixture of research. First, of course, there were the marvelous developments of real new materials. The materials base of the transistor and the integrated circuit. The crystals for lasers. New ferrimagnets and ferroelectrics. The new superalloys and glass-ceramics and on and on. Real materials leading to real products. But alongside these, and soon over and around this world of real materials, grew up an enormous baggage of more abstract and more abstruse science. This science aspired to "rigor," and mathematical approaches and eschewed much contact with the world of real materials. Thus because of these peculiar historical accidents and forces, by the 1970's, materials science had de-materialized into more and more abstract science, and this was regarded as the only worthwhile science. This was the value system dominating academia, but it pervaded the professional society and industrial research laboratories as well. Thus was genuine, real science understood and supported by the public, slowly replaced by other work which the public and much of the scientific world could not understand and yet was expected to support.

In the eighties, with the relative decline of U.S. technology compared to Japanese and German technology, where none of the so-called "basic research" was done, it slowly dawned on CEO's of U.S. companies that irrelevant-to-product abstract science has no possible return on investment. By the early nineties it was all over in industry, with the virtual abolition of the corporate research labs and the radical excision of much of the very abstract science. However, the scientific community (the professional societies, etc.) dominated by academia, have yet to get the message. Even in materials research the legacy of detailed studies of point defects and partial dislocations and 1Å TEM persists and creates an inverse square law, with prestige diminishing with relevance in the real world. This conference has attempted to start reversing this process by seizing the high ground. Innovation in real materials that one can touch, feel and make a pound or ton of is the core of materials science and engineering.



## REDRESSING THE BALANCE: HOW

The task for the professional (materials) community now is to restore that kind of research that leads to (useful?) real materials to the central position of honor within the community. Of course, over the next decade the private and public sector budgets for research will slowly right themselves. But it behooves scientist-citizens to help instead of hinder this society's adjustment to the new realities. Who better than the National Association for Science, Technology and Society (NASTS) to take on the task. This is the only professional society concerned with society first, in its relation to science and technology. The American Association for the Advancement of Science's (AAAS's) goal is to advance science; NASTS's goal is to advance society. NASTS' executives conceived the idea of creating a series of awards to recognize those who had made the greatest contributions in the real materials area and approached the Federation of Materials Societies to help them in achieving a system for community peer review in identifying the most significant contributions.

In order to broaden the base and yet set a very high standard, nominations on specific forms were invited only from the members of the Materials Section of the U.S. National Academy of Engineering and the Presidents of the various materials societies. The nominations were ranked by a committee of distinguished senior materials researchers, representing a spectrum of fields and drawn from industry, academia and government, listed below.

G. Dieter, Dean of Engineering, University of Maryland; Past President, FMS and ASEE
J. J. Gilman, Professor of Materials Science, UCLA; Senior R/D Manager with GE, Allied Signal, Standard Oil
A. M. Diness, Institute for Defense Analysis; Former Associate Director of Engineering, ONR; Head, ONR, London
R. A. Laudise, Director, Materials, AT&T Bell Labs
J. E. Nottke, Senior Research Fellow, Dupont
R. Roy, Evan Pugh Professor of the Solid State, The Pennsylvania State University; Principal Architect of the Materials Research Society



A small grant was secured from the Okinaga Foundation to cover the costs of the selections and the Award ceremony. We were honored that Dr. Shoichi Okinaga, President of the Teikyo Group of Universities—probably the largest such in the world—chose to be present and address the group.

## THE RESULTS

The symposium was, appropriately, held at the National Press Club. The media turnout was modest. NBC ran a short piece on one of the winners. The National Technological University recorded all the presentations for a nationwide broadcast to its network of industrial and university labs. The proceedings will appear in various journals and will be widely disseminated through the materials educational system, especially via the *Journal of Materials Education*.

By many measures, for the first attempt in uncharted waters, the RAM Symposium was a great success.

First, the committee looked at the set of selections and felt that, of course, with the usual fuzziness at the boundaries, the materials community could be proud of this set of achievements.

Second, the awardees nearly uniformly had the reaction: Isn't it wonderful to be recognized, at last.

Third, visitors, the Foundation sponsor, government agencies, and so forth, were all uniformly appreciative of the event.

We are particularly pleased that the *International Journal of Polymeric Materials* is devoting space to this significant event, including the abstracts of all the awardees' papers. In the new world of materials science where oxide glasses displace metallic wires and polymer matrix composites displace ceramics and metals, no class of materials can ignore the other. Moreover, as composites take over territory from single phase materials, see for example the two examples by Newkirk (ceramic + metals) and Newnham (polymer + ceramic), it behooves all materials scientists to be aware of the competition!

## THE FUTURE

It is clear that one cannot have an annual event to honor developments in a certain field that typically take ten years to prove themselves. However, there was immediate demand to repeat the process in other applied science fields—energy, earth, agriculture, health, and so forth. Thus, for example, using a five-year cycle, it would be appropriate for the scientists concerned about restoring a healthy balance in the image of science to hold such an annual International Symposium to honor Real Advances in other sciences. This is being vigorously pursued by NASTS.



## LIST OF AWARDEES

The 16 individuals and groups that were selected as "Gold Ribbon" awardees represented those that the committee felt had demonstrated the impact which their scientific research in creating a new real material had had on technology and thence on society, usually via the marketing of a real product.

The "Blue Ribbon" awardees were not necessarily in a second rank. But, as it takes a decade for a new material to really enter a market, it is clear that some may not yet have reached that stage. There are also judgment calls on some very exciting discoveries—"breakthroughs"—as being too "young." These may be very interesting in the isolated laboratory case, but may never even make a real product, leave alone making it to the production line.

The two sets of awardees are listed in the following section.

## LIST OF GOLD RIBBON AWARDEES

### Ceramics

**Joseph Davidovits and James Sawyer**, Lonestar Cement Co., *Very Early High Strength Cement*

**Edith Flanigen**, U.O.P., *Zeolites Based on* $AlPO_4$

**L. J. Gauckler**, Swiss Federal Institute of Technology, *Enzyme Catalysis of Ceramic Forming*

**David Hoffman, R. J. Riedner, C. Greskovich and D. Cusano**, Ge R/D and Medical Systems, *HiLight Ceramic for Improving Medical X-ray Practice*

**S. Matsumoto, M. Kamo, Y. Sato and N. Setaka**, NIRIM, Tsukuba, Japan, *The Development of Methods to Product Diamond at One Atmospheric Pressure by CVD*

### Composites

**Marc Newkirk**, Lanxide Corporation, *Directed Metal Oxidation for New Materials Processing Technology*
**R. E. Newnham and L. E. Cross**, Penn State, *Composite Transducers for Electromechanical Applications*

### Electronic/Photonic Materials

**Philippe Becker, Elias Snitzer and David Payne**, AT&T Bell Laboratories, *Erbium Doped Optical Fibers*
**Alfred Cho and colleagues**, AT&T Bell Laboratories, *Materials for Cascade Lasers*
**A. W. Sleight**, Oregon State University, *Perovskite-based High $T_c$ Superconductors*

### Metals

**David Claspell, John Croat and Jan Herbst**, Magnequench, *Rare Earth Boride Magnets*
**Raymond Hemphill and David Wert**, Carpenter Technology, *Aermet 100, High Strength, High Toughness Steel*
**K. Inomata**, Toshiba Research Center, Kawasaki, Japan, *New Metallic Glasses for High Frequency Applications*
**Edward Steigerwald**, PCC Airfoils, Inc., *Single Crystal Aircraft Turbine Blades*



### Polymers

**Carlton Ash and colleagues**, Shell Development Comp., *New Polyketone Thermoplastics*
**Sheldon Kavesh and Dusan Prevorsek**, AlliedSignal Inc., *Spectra ®Polyethylene Fiber*

## LIST OF BLUE RIBBON AWARDEES

**D. K. Agrawal and colleagues**, Penn State, *New Zero Expansion Ceramic Family NZP-CTP*
**R. M. Beasley and colleagues**, Lockheed Missiles and Space Company, *Rigidized Structural Ceramic Insulation*
**H. S. Gandhi, J. S. Hepburn, K. S. Patel and M. G. Meneghel**, Ford Motor Company, *Rhodium Free Automotive Three-way Catalytic Converter*
**J. B. Goodenough**, University of Texas, *Materials for Lithium Battery Electrode*
**Shimshon Gottesfeld**, Los Alamos National Laboratory, *New Fuel Cells for Transportation*
**Sridhar Komarmeni and colleagues**, Penn State, *Ceramic Nanocomposites Via the Sol-gel Routes*

**K. M. Prevo and colleagues**, United Technologies Corporation, *Glass-Ceramic, Structural Composites*

**Maurice Ward**, Ward-Starlite Limited, *High Performance Insulating Materials: Starlite*

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