Issues in Materials Manufacturing

In late January, the Bush administration announced that it was proposing an Advanced Materials and Processing Program (AMPP) as a new FY93 initiative "...to improve the manufacture and performance of materials to enhance the nation's quality of life, security, industrial productivity, and economic growth." This proposal carried with it a budget request to Congress for an additional 10% funding for materials R&D. Barely one month later the President's science adviser, D. Allan Bromley, announced that a Manufacturing Initiative would undergo intense study and planning this fiscal year in preparation for proposed funding in FY94.

The April *MRS Bulletin*, with its focus on materials manufacturing, gave readers timely technical insight into this aspect of materials science and engineering for several materials industries and manufacturing methodologies. As a further attempt to sharpen the awareness of scientists, engineers and managers, and to more clearly identify issues inhibiting the successful application of laboratory work, we asked representatives knowledgeable about manufacturing in several industries to present their views about the research-to-manufacturing process. The following comments are from Ed Bostick, who has spent a career in polymer manufacturing; from John Fan, who currently heads an advanced electronics materials fabrication company; and from Peter Johnson of the Metal Powder Industries Federation.

Most materials scientists are well aware that implementing their laboratory discoveries and developments in a manufacturing or fabrication setting is a slow, difficult process. We welcome additional comments from the materials community as the Materials Research Society examines both the issues associated with materials manufacturing and the Society's possible role in improving the situation.

Gordon E. Pike
Manager, Materials and Process Sciences Operations Office
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Chair, MRS External Affairs Committee

It's About Time

There seems to be a ground swell of soul-searching and self-examination by almost every social group in the United States about our productivity, especially about the manufacturing process which creates capital goods. It's about time.

The science and technology community has an excellent record of creativity and innovation. Tens of thousands of patents exist. Our literature is active and full of new observations that have scientific merit. Then, what is the problem?

I believe we have lost the ability to translate and implement this vast scientific wealth into manufactured goods for use by our world society.

As a result, science and technology have fallen into disfavor with the national forces that control financial resources. This situation has led to a spiral of downsizing, importing offshore research and development, and loss of leadership.

What should be done? Well, all scientific institutions in this country are part of a team even if they don't realize it. This includes academia, government, and industry. This team should first focus on plans to solve implementation issues and relate these plans to the National Academy of Sciences for real action. Does the government get involved? Of course it does, but not with endless parochial bureaucracy and stonewalling.

I suggest the following:

1. Encourage university/government/industry/scientific relations.
2. Encourage cooperative studies for graduate students in the manufacturing industry and government.
3. Organize informally into groups of advanced pathfinders, program technologists, and trouble shooters (i.e., problem solvers). Protect the advanced group at all costs.
4. Determine the needs of our society. Select the ones that appear worthwhile and focus on those.
5. Achieve excellent basic process and product design, which will heighten quality and simplify manufacturing.
6. Reduce paperwork, useless reports, and layers of supervision.
7. Instill in our young advanced scientists and technologists the idea that manufacturing is interesting, challenging and exciting, and not beneath their dignity.
8. Encourage only the advanced pathfinders to spend money on a scientific endeavor if there is no perceived need or customer for it.
9. Learn to listen and reduce the cathedrals of special interests from the scientific and technological environment.
10. Market science and technology! Get the order! Satisfy customers!

Edgar E. Bostick
President
Ed Bostick Technology Inc.

Material Matters is a forum for expressing personal points of view on issues of interest to the materials community.

Materials Manufacturing Should Be a Practical, Acceptable Goal

As most of us are aware, advanced materials, ranging from semiconductors, superconductors, ceramics, etc., are the building blocks for whole generations of new devices and components. In many aspects, they will form the enabling parts of many systems. There is no lack of scientific knowledge and discoveries of advanced materials in this county; however, there is a strong need for manufacturing know-how for these materials. There are, of course, entrepreneurial companies which focus on pioneering the commercialization of advanced materials. Successful adoption of these manufactured materials, which admittedly are in the beginning of the chain, requires many enabling elements other than scientific know-how. Large capital investments are needed, especially in developing production machines, which are usually custom designed and constructed for advanced materials. Because several machine generations are usually needed, a stable, cohesive scientific and engineering team, coupled with a long-time commitment by the top management, are required. All these attributes are usually lacking in small start-up companies. Large U.S. corporations, on the other hand, have a strong aversion to getting into material manufacturing areas since such investments frequently do not satisfy their near-term financial returns.

As this dilemma continues, investments dry up, infrastructures weaken, and advanced materials (or materials in general) are manufactured abroad. The wealth of scientific and engineering talent in the U.S. academic institutions will have limited career opportunities, and the governmental agencies will begin to question the usefulness of all their funding if no serious commercialization in new materials results. I believe this chain of events is already happening. We must reverse this trend, or our competitiveness in materials, and hence devices and systems, will be greatly undermined.

It is essential that we begin a serious discussion on how to make materials manufacturing a practical, acceptable goal. This requires the coordinated efforts of small and large companies, government agencies, academic institutions, and professional societies. The issues involved are multiple, and the time to put our hands around them is now.

John C.C. Fan
Chairman & CEO
Kopin Corporation

Powder Metallurgy Struggles with Lengthy Lead-Times

As a manufacturing technology for precision metal components, the powder metallurgy field has struggled with lengthy lead-times for turning R&D and pilot-plant ideas into commercial products.

One industry expert told me it can take 10-20 years to develop a new material into a commercially acceptable, viable product. Besides the staying power needed to develop new technology, people are sometimes reluctant to change. Engineers feel comfortable with the parameters of a tried and tested material, and are slow to change to new ones. Many companies are also constrained by management guidelines that call for quick payback times for an investment. It is tough to get visionaries onto boards of directors who will back a new idea for a long period of time.

The metal injection molding sector of the powder metallurgy industry has been around for at least 15 years. Much R&D effort has gone into this technology in raw materials and process equipment. But only in the last few years has metal injection molding reached the commercial stage of supplying products in critical applications in aerospace, defense, computers, firearms, and biomedical products. Today, about 60-70% of the orthodontic clips we use are metal injection molding products.

The forging of powder metallurgy performs is another case in point. This technology took quite a long time to develop, but soon all "Big Three" car companies will be using powder metallurgy hot-forged connecting rods in their engines. Ford was first, taking the plunge in the 1.9 liter engine for the 1987 Escort and Lynx models.

Better communication among researchers, development engineers, and production people is needed to speed up the process from the lab to the production floor. Management also needs to be brought into the loop. And of course, every new technology needs its "champions" who persevere despite all odds.

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JULY 1, 1992

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