ADVANCED MATERIALS

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BMFT Materials Research Program

By Dieter Kutschke*

The Importance of Materials Research

Materials research plays a pivotal role in the research efforts of the leading industrial nations such as the United States, Japan, the United Kingdom, the USSR, France, the Federal Republic of Germany, etc. This is a natural consequence of the key function of materials in any technological and economic activity. In a system of competing economies, the best possible selection and design of materials and thus the use of improved and new materials is an entrepreneurial necessity. New and improved materials are not, as a rule, just invented, but, as has been shown in the last few decades, are the result of systematic materials research. Technological progress and the further development of industrial products and processes frequently call for the existence of high-performance materials.

In 1985, in response to this challenge, the Minister for Research and Technology of the Federal Republic of Germany launched a ten year Materials Research Program, for which the Federal Government intends to make approximately DM 1.1 billion available in research grants.

Three years after its initiation a first interim review of the progress being made within the framework of this program is now arranged. A major part of the interim review is the 1988 Materials Research Symposium due to be held at Hamm/Westphalia from September 12 to 14, 1988. No fewer than 70 reviews and specialized papers, dealing with a broad range of results from basic research to applications-oriented materials development will be presented.

Aims of the Materials Research Program

In general, the program aims at a long-term improvement in the industrial efficiency and competitiveness of the Federal Republic of Germany based on the development and use of new structural and functional materials. The intention is to mobilize the scientific and technological potential of highly qualified research groups in basic and applied research institutions together with those employed in industry, so as to solve selected research and development tasks. The basic concept is that it is the original task and responsibility of industrial enterprises to conduct R&D in order to lay the foundation of their future competitiveness. The Materials Research Program has been designed above all to help advance applications-oriented basic research of a type likely to yield results which can soon be put to use in the development of new and improvement of established materials. It is essential that existing skills and capabilities be strengthened by encouraging cooperation between scientific and industrial establishments. A concerted effort is called for in several respects: firstly, concentration on a limited number of research priorities; secondly, participation of all highly qualified research institutions in the program; and thirdly, the integration of basic research and industrial development. Such a concerted effort would open up an important, as yet largely untapped potential and would at the same time offer an opportunity for the highly efficient deployment of pro-

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Contents

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Table 1. Organization of co-operative research and development projects. Example: high-strength, fiber-reinforced ceramic-matrix composites.

Objectives	Application	Collaborators

- Improvement of crack propagation of high-strength materials ceramics by incorporating ceramic fibers and whiskers
  - increase in strength
  - increase in resistance against mechanical and thermal shock
  - improvement of high-temperature properties
- Development of parts and simple-shaped components
- Matrices: glass, glass ceramics, Al_2O_3, SiC, Si_3N_4
	Structural components for application at low and at high temperatures and this demanding improved tolerance levels	*Industry*
		Schott AG, Mainz
		Hoechst AG, Frankfurt
		Sigri GmbH, Meitingen
		Institutes
		DFVLR, Köln, Institut für Werkstoff-Forschung
		Battelle, Frankfurt
		Technische Universität Karlsruhe
		- Institut für Chemische Technik
		- Institut für Keramik im Maschinenbau

gram funds, by including industrial research to a large extent.

The program covers the following priority areas:

- high-performance ceramics
- powder metallurgy
- metallic high-temperature materials
- high-performance polymers
- composite materials

Cooperative research projects of the kind described above enjoy preferential support by the government: industrial enterprises, universities and research establishments are encouraged to pool their research facilities in order to jointly tackle, by sharing assignments and exchanging experience, R&D problems which are interrelated in terms of subject and function. Depending on the problem concerned, on the parties participating in the project, and on the particular circumstances, practical collaboration under such a cooperative research project can take different forms. The patterns of cooperation range from binding agreements on an exchange of R&D results to the execution of joint research work in one laboratory. Table 1 outlines a typical cooperative research project.

The costs of the cooperative research projects are shared by industry and the Ministry of Science and Technology (Bundesministerium für Forschung und Technologie, BMFT). In order to ensure the highest possible degree of efficiency in the cooperation between industry and its research partners (institutes), the firms are required to share in the expenditure incurred by the institutes. Generally speaking, the BMFT shoulders 50% of the total cost of the cooperative project. The participating industrial partners bear the remaining 50%, that is 50% of their own costs plus 50% of the expenditure incurred by the institutes.

In the past three years, cooperative projects incurring a total cost of DM 931 million have been started. The BMFT bears DM 497 million (Table 2).

Table 2. Priority areas and funds of the R&D activities within the BMFT Materials Research Program to date (in million marks).

Priority areas	Total R & D cost	BMFT share
High-performance ceramics	232	119
Powder metallurgy	96	59
High-temperature metallic materials	168	95
High-performance polymers	199	104
Composite materials	236	120
Total	931	497

The aim of mobilizing the scientific and technical potential has largely been realized. Closer cooperation between industry and scientific institutes at universities, the Max Planck Society, the Fraunhofer Society, the National Research Centers and the Federal Materials Testing Institute has been launched efficiently and to the mutual benefit of the private and public partners. The program is being carried out in close collaboration with the German Research Society (Deutsche Forschungsgemeinschaft, DFG), and has triggered off additional research activities. Further activities in materials research, in the form of new research programs or the foundation of new institutes, have taken place in all Federal States in the past three years. A number of EUREKA projects as well as the increased utilization of the BRITE and EURAM programs of the European Community are conducive to strengthening materials research at the European level.

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