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Materials Research in Germany and Chances for International Scientific Cooperation

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Synthesis and processing of high grade materials is identified world-wide as key-technology for the development of new products and processes. Therefore, in the technologically leading countries, R + D in this field is strongly supported by governmental programmes. With increasing interdisciplinarity and long-term orientation of R + D-work, international scientific cooperation is becoming more attractive and promising.

1. The German programme for Materials Research (1985 - 1994)

The Federal Ministry for Research and Technology (BMFT) has been supporting R + D-activities in the framework of its materials research programme since 1985. R + D for synthesis and processing of bulk materials and coatings, with new or improved structural and functional properties are concentrated on the topics Ceramics, Powdermetallurgy, High Temperature and Special Materials, Polymers and Composites (1, 2).
Other materials related programmes, active in the field of Thin Film Technologies, Surface Technologies, Superconductors, are not reported here in details.

The task of the Project Agency Materials and Raw Materials Research is to carry the programme into effect.

The scientific-technical goals are e.g. improved thermal stability, corrosion-, thermoshock- and creep-resistance, strength, stiffness, light weight design and special electrical, optical, magnetical properties.

Support of R + D is concentrated on joint projects with close cooperation between industrial laboratories and research institutes. Based on the regulations of the Commission of the European Communities, the governmental contribution is 50 % of the total project costs. Between 1985 and 1992 in total 577 joint projects with 1.111 cooperative R + D-partners have been supported. The total project costs and the governmental grant, distributed on the programme topics, are shown in Table 1.

materials specific budget distribution	Industry Total budget mill.DM	Industry Grant budget mill.DM	Institutes Total budget mill.DM	Institutes Grant budget mill.DM
Ceramics	328.7	155.8	82.4	57.7
Polymers	341.6	156.9	32.2	31.5
Composites	292.0	137.0	34.8	32.3
HT-SM	207.6	97.5	71.0	64.8
Powder metallurgy	148.8	71.1	30.9	30.0
Corrosion + Tribology	41.2	20.5	33.3	32.9
Total	**1,359.9**	**638.8**	**284.6**	**249.2**

Selected examples of R + D-results from supported projects are:

- High purity silicon nitride powder for low cost components in high temperature applications
- Microwave sintering of ceramic components
- Silicon nitride powder for high-temperature-strength components
- Silicon carbide material for large components in heat engineering
- Ion conductive ceramic for batteries
- Fibre reinforced aluminium and magnesium with improved strength at elevated temperatures
- Metal injection moulding for steel machining parts
- Light metal alloys with 5 - 6 % Li-content
- Superalloys for application at 1100 °C
- Intermetallics for applications above 1200 °C
- Shape memory alloys
- Aromatic thermoplastic processable polycarbonate with a glass transition temperature of 190 °C
- Liquid crystalline polymers
- Optical polymers for light transmission
- Electrical conductive polymers
- Photoresists with high resolution
- Ultra thin polymer layers for optical and electrical applications and sensors
- Low cost in line production of fibre reinforced polymers for automobile components

2. Evaluation of the Programme

The Materials Research Programme has been evaluated in 1992 by Arthur D. Little Int. Inc., Wiesbaden, Germany, to analyse the effectivity of the programme, to identify the future priority goals in materials science and to summarise recommendations and guidelines for future actions and activities (3).

Regarding the programme period 1985 - 1992 the evaluation study concludes:

- The goals and the approach of the programme has been focused on significant topics
- The close cooperation of institutes and companies in joint projects is efficient, successful and continuation is strongly recommended
- Efficient R + D-structures have been established
- R + D in materials research in Germany is at an internationally high level
- Competitive results have been achieved

The conclusion and recommendations in the study for future R + D in materials research are:

- Synthesis and processing of materials with improved performance is one of the most important key-technologies for international industrial competitiveness.
- Improved materials are the keys for innovations in Information technology, Energy technology, Traffic/Transportation and Medicine.
- R + D in materials research should focus on joint projects, oriented towards application of new materials in these key-technologies.
- Partners in cooperative joint projects should consider steps of increasing value from materials via components to complete systems.
- Transfer from R + D-results to practical applications must be accelerated by participa-

tion of system producers.

- Besides the technical features and the economy of products and processes, the importance of ecological aspects is increasing.

- International cooperation should be intensified in the area of long-term oriented R + D.

3. International Cooperation

For years, R + D in materials science is becoming increasing interdisciplinary and complex character, with ever-increasing timespan between results and innovations, with expanding costs for labour and equipment. At the same time, globalization and acceleration of innovation processes are observed. International joint projects could contribute to overcome these problems, when R + D tasks are shared by cooperating partners with high competence on an international (bilateral or mulitlateral) level.

In Europe, there are different types of international scientific cooperation (not only materials research). In projects in the framework of the initiative EUREKA (EC- and EFTA-member states), industrial companies (at least two from two member states) including research institutes are working together in the field of precompetitive R + D . Most of the EUREKA-Projects are not supported by governments. In the case of financial grant, the money is allocated from national programmes.

Another model for European cooperation is the initiative COST (Coopération européenne dans la domaine de la recherche scientifique et technique), where R + D-partners from at least five COST member states (EC, EFTA and countries from Eastern Europe) are working together with support through national programmes.

The Commission of the European Communities (CEC) is supporting R + D in materials science with the programme BRITE/EURAM, where at least two companies/institutes from two EC-memberstates are working together.

VAMAS (Versailles Project on Advanced Materials and Standards) is the frame for materials related prenormative cooperation between Canada France, Germany, Italy, Japan, UK, USA and the CEC.

Under the umbrella of an IEA-agreement Germany, Japan, Sweden and USA are working together in the field of characterization and machining of high performance ceramic.

For the intensification of international cooperations for cost effective acceleration of the innovation process, suitable R + D-topics remain to be identified.

R + D-Topics in materials science in a very precompetitive area - with a timespan from first R + D-results to practical application at more than 10 years - could be favourable areas for intensified international cooperation between companies and research institutes in Europe, USA and Japan.

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