Action Plan 2010-2013

Materials Science Area

EXECUTIVE SUMMARY

N.B.: If you require any further information about the specific content of any particular Area 6 Centre or Institute´s Strategic Plan, please ask for it by sending an e-mail to: pe2010-13@csic.es. Thank you

CONTENTS

6 Materials Science Area

1. GENERAL INFORMATION

Description of the area

At present, the Area comprises 11 institutes, 2 more than at the start of the current strategic plan. These centres are located in 6 different autonomous regions of Spain. The Area has a staff of almost 500 researchers (public employees on the research professor, scientific researcher and tenured scientist scales) who published approximately 5,800 papers in indexed scientific journals and supervised 320 doctoral theses during the period 2003-2007.

The Materials Science and Technology area looks to a future where society (in its broadest sense, including all strata) has available to it a wide range of convenient products which improve life and extend lifespan by facilitating everyday tasks, improving the conditions of the sick and aged, improving companies' prospects and generating wealth without harming the environment. And all of this through new technical means facilitated by innovative materials with properties and functionalities discovered or enhanced by research.

The Area undertakes research along several lines, with connections or shared zones of action with other Areas (in particular, Area 5: Physics and Area 8: Chemistry), contributing knowledge ranging from basic materials science through to the development of technology applications. In view of its relative weight in the various institutes and strong representation, these represent the essence of materials research in the CSIC, and it would be true to say that it accounts for the lion's share of national output in materials science and technology.

.

Short history

(Covering the period 2006-2009)

The Area has evolved, and since the creation of the materials science centres in the 1990s and their integration with the centres dedicated to the area of materials technology from the former Patronato Juan de la Cierva, an initial nucleus has been complemented with the creation of new centres covering specific new aspects of the area's thematic focus. Last year the Centro de Investigación en Nanotecnologías y Nanomateriales (Nanotechnologies and Nanomaterials Research Centre, CINN) was created –although it does not yet have its own building– and a joint centre with the Madrid Polytechnic University is in the pipe-

line, the Centro de Investigaciones de Seguridad y durabilidad de estructuras y materiales (CISDEM), which will cover research into the safety and durability of structures and materials.

Mission and Vision

Mission

The mission of the CSIC's Materials Science and Technology Area is to "promote and perform research to serve society by advancing the science and technology of materials." The application of materials to new uses can only be achieved by improving their properties by means of innovative treatments and processes. Similarly, imagination in the service of these objectives will produce new materials with properties as yet unimaginable.

To achieve this it aims to coordinate the activities of the centres of which it is comprised, promote initiatives and bolster emerging lines of research of interest to society.

Vision

The Materials Science and Technology Area aims for its R&D activities to be a benchmark both nationally and internationally. At the international level it aims for leadership in some of its lines of research. Nationally, where this leadership already exists, it wishes to maintain this leadership and achieve similar performance in knowledge transfer to industry, whether in Spain, Europe or elsewhere.

Institutes and Centres that comprise the Area

- Centre for Materials Physics (CFM).
- National Centre for Metallurgy Research (CENIM).
- Nanoscience and nanotechnology research centre (CIN2).
- Nanomaterials and nanotechnologies research centre (CINN)
- Aragón Materials Sciences Institute (ICMA).
- Instituto de Ciencia de Materiales de Barcelona (ICMAB).
- Instituto de Ciencia de Materiales de Madrid (ICMM).

- Seville Materials Sciences Institute (ICMS).
- Polymer Science and Technology Institute (ICTP).
- Glass and Ceramics Institute (ICV).
- Eduardo Torroja Institute of Construction Sciences (IETCC).
- ESRF - SPLINE
- ILL - SpINS

2. CRITICAL ANALYSIS OF THE AREA

SWOT ANALYSIS

Weaknesses

- The excessive fragmentation of research groups and absence of joint efforts.
- Participation in international projects in which it has limited responsibility.
- Doctoral training activities are limited.
- Unbalanced workforce, in which the number of scientists (with advanced and mid-range qualifications) has risen, but the numbers of technical personnel and other support personal have not grown in proportion.
- Lack of a career structure for non-research personnel at the CSIC, particularly in management and technology.
- Limited generation and exploitation of patents.
- The small size of companies in Spanish industry and lack of a tradition of research in companies, is an obstacle to their RTD investments.
- Current university curricula have not yet taken on board the importance materials science is acquiring and have therefore either not implemented these specialisations in their faculties or the specialisations have not been perceived by students.
- The CSIC's transformation into an agency, which could translate into greater operational flexibility and a decentralisation towards institutes to manage the hiring of staff and acquisition of other resources, has not had these benefits.

Threats

- The global economic crisis may mean that funds devoted to R&D and innovation are directed towards other areas which produce a return in the very short term.
- The lack of a long-term scientific policy may mean that the efforts of recent years are not effective at consolidating a modern and comprehensive structure at the Area's centres.
- The equivalent centres that are being created in the various autonomous regions and which have greater flexibility when it comes to hiring high level researchers are causing the CSIC to lose its competitive edge when it comes to attracting human resources.
- The number of students going to university is falling perilously, and it is getting harder all the time to find doctoral students.

Strengths

- The Materials Science Area published almost 5,800 papers between 2003 and 2007 (obviously not all in journals in the area), which gives an idea of its strength in this field, in which Spain is twelfth in the world rankings, with 7,000 publications.
- The CSIC's infrastructure makes it possible to exploit synergies with other centres or areas.
- The multi-disciplinarity that exists within the area enables teams of experts in different aspects to be formed to address a given topic.
- The implementation of the previous strategic plan has enabled the research workforce to be increased significantly, and to provide the Area's centres with more modern equipment.
- Materials societies exist in Spain, Europe and elsewhere that serve as a forum for collaboration and the organising of major congresses.

Opportunities

- There is a specific NMP (nanoscience and nanotechnology, materials and processes) thematic area in the Seventh Framework Programme.
- The existence of a national plan for materials means that there is a framework for obtaining financial support for more basic research.
- The current economic downturn will make it necessary to look for new solutions as a way out of the crisis, and given the use of materials in all sectors of industry, this will open the door for the transfer of the

results of research.

- The creation of ALBA may help expand the use of these large facilities for the study and development of new materials.
- The establishment of a materials committee in the ESF will have a stimulating effect and will differentiate our research, enabling a bolstering by separating it from well established disciplines which consume a large share of the budgets.
- The new interministerial plans and strategic axes will open up new prospects for our researchers.

THEMATIC FIELDS

1. *Functional and multifunctional materials. (Photonic, magnetic, hybrid, thin films and coatings).*
2. *Structural materials for sectors of high industrial interest.*
3. *Materials and engineering for construction.*
4. *Design, modelling and simulation of materials.*
5. *New synthesis and processing methods.*
6. *Properties of materials on the nanometric scale.*

In accordance with the action plan drawn up by the Area's centres, its research is grouped into 45 lines (106 sub-lines). However, by thematic affinity it is possible to group them thematically in just 12 branches.

Research lines	
Line 1	Materials for energy generation and conversion
Line 2	Materials for the environment
Line 3	Biomaterials for health and improved quality of life
Line 4	Materials for the information society
Line 5	Photonic materials
Line 6	Advanced materials processing
Line 7	Theory and Structure of Matter
Line 8	Advanced characterisation of materials
Line 9	Mesoscopic systems, surfaces and interfaces

Line 10	Functional/Molecular Organics
Line 11	Structural Materials
Line 12	Materials Engineering

3. ANALYSIS OF THE AREA'S 2006-2009 STRATEGIC PLAN

The level of fulfilment of objectives in the Area was close to 100%, with small ad hoc deviations due to temporary situations which have since been rectified.

4. OBJECTIVES 2010-13

GENERAL OBJECTIVES

- The Area's main aim is to create, in a sustainable way, tangible benefits for society in the form of materials with enhanced properties, new properties, new applications and a deeper understanding of the origins and potential of the properties of materials, and the basic science which makes it possible to open the way for research into materials which, although they may not have applications today, will have them in the future.
- It is essential to inculcate in centres, and consequently researchers, the need to make the research effort in Spain to be reinvested in society somehow, not just Spanish society, but humanity in general.
- Achieving greater involvement of society in research, and vice versa, so that the Area responds to real demands and problems.
- Establishing a scientific and technical population on all scales that makes it possible to respond to the challenges of today and tomorrow effectively. This also includes administrative and management functions.
- A primordial goal is the training of new and better scientists as enablers of progress in materials science. Training of management staff in the increasingly international stage on which research takes place is also necessary.
- That scientists receive the support they need from a diverse range of technicians who enable them to work more flexibly and more efficiently.

- Formation of better teams and establishing of lasting collaborations and networks of synergies. Facilitating temporary mobility of researchers between centres.
- The Area's ability to attract resources needs to be improved so its scientists are free to express their creativity.
- It is likewise important to stimulate centres to improve their performance and the quantity and quality of their output, whether scientific, technological or academic.
- Encouraging and stimulating the Area to keep itself up-to-date about social needs and research opportunities so as to improve response times and the adaptability of teams.
- Convincing industry of the benefits of investing in research and taking part on joint projects with laboratories. The possibility of institutes temporarily hosting researchers or industrial technologists, or vice versa, could be explored.

SPECIFIC OBJECTIVES

- The new centres, which, in the majority of cases, are focused on lines of general interest and emerging lines, need to become established.
- Promoting participation in international projects and programmes, encouraging leadership in initiatives.
- Integration with the strategic axes defined for 2010-2013, relevant for the area, namely Energy, Global Change, Water Resources, Advanced instrumentation and Engineering, Aging and Quality of Life.
- Achieving a situation in which the centres, particularly newly created ones, reach a critical volume that enables them to achieve their objectives.
- Trying to define an optimal size for the various centres so as to try to reach this size and maintain it over time by facilitating the creation of new centres or splitting up of existing ones.
- Assuming more direct responsibility by the area, through the commission, in the evaluation of the centres' activities.
- Obtaining resources to be distributed according to the level of fulfilment of these objectives.
- Maintaining and promoting specific courses for trainee personnel that will allow them to achieve a more global vision of materials science and technology.

- Attracting the best scientists
- Obtaining greater visibility
- Consolidating levels of publications.
- Improving and obtaining real patents, with a view to their subsequent exploitation, for which support will be given to those obtained under joint-ownership arrangements with business.

5. RESEARCH STRATEGY AND ENVISAGED ACTIONS

Envisaged Actions

Seeking to convince the centres that the current action plan has positive features and that fulfilling it (after an improvement to the evaluation methods) will have a significant impact on the centre's future.

Promoting and facilitating the fitting out of quality spaces and infrastructure with which to perform research work; and taking on board the challenge of updating with ever more sophisticated equipment developed in the area, including the provision of repairs and maintenance to it, together with the technical personnel for its use and maintenance.

Encouraging researchers to place their talent at the service of the Area by means of incentives and reward quality work. A policy of readjusting resources based on the interim assessment will serve for this purpose. Here places are reserved for awarding in the second period of the AP.

Achieving a balanced promotion, rewarding efforts and merits over seniority. To do so we need to ensure quality research and its results are rewarded and therefore it is necessary to set up panels both for promotion and recruitment. These must be not only impartial but also competent and able to appreciate genuine merit while being unswayed by their own interests.

Studying, proposing and implementing more versatile and objective methods for assessing activity that are able to evaluate quality results even when not planned for.

Bolstering emergent lines, consolidating efficient lines, discontinuing obsolete and ineffective lines, increasing transfer, internationalisation, dissemination, etc.

Establishing a rate of production not only of science but also of stable scientists to perpetuate research capacity. Promoting the incorporation of a share of PhDs trained in industry.

Starting or increasing participation in final year projects with technical universi-

ties.

Consolidating the final stages of the doctorate through doctoral masters given by the CSIC. This has two purposes: encouraging the specialisation of doctoral students who are being trained in the institutes in the materials area and attracting university students to take their doctoral thesis.

Achieving greater interaction with universities: participation in doctoral courses or masters, joint scientific projects, creation of affiliated units, etc.

Increasing the level of integration of the Area's centres and groups through collaborations, joint supervision of doctoral theses, joint publications, available techniques, mutual knowledge in general.

Promoting agreements with organisations in other countries in order to raise the internationalisation of the Area's centres and increase their participation in international projects. Encouraging prestigious foreign researchers to take sabbatical at our centres.

In order to increase the impact of our research, it is necessary to strengthen the links with society by means of greater dissemination of results.

The Area's presence at science fairs will enable us to reach the general public and bring materials science closer to its end users.

In order for the line up of actors in the milieu to permit the pace to be maintained, it is necessary to take materials science into the classroom –not just in universities, but in schools as well– so as to arouse curiosity and stimulate the minds of future scientists and users. This is the only way in which we can ensure an adequate population of students to fill our laboratories.

Reaching the pages of the newspapers, television, etc. is one of the most effective ways of reaching a broad public. It is necessary to get close to the media and establish permanent connections with the few producers of popularising programmes and take the progress in the area to them.

No other objective is as important in reaching industry and making it aware of what the Area can offer, and establish fluid channels of communication that stimulate researchers to meet technological challenges and promote productivity in industry and raise their competitiveness.

Executive Summary

CSIC