

PS PUBLIC SERVICE REVIEW

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an independent review

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A success story

*25 years of research
in materials...*

In 1986, an initiative of the Spanish National Research Council (Consejo Superior de Investigaciones Científicas (CSIC)) – the largest public institution dedicated to scientific research in Spain and the third in Europe – led to the founding of the Materials Science Institute of Madrid (Instituto de Ciencia de Materiales de Madrid (ICMM)). The decision was aimed at strengthening CSIC research activities in a field of growing importance, materials science, through the creation of a new institute that brought together chemists, and experimental and theoretical physicists who were previously scattered across four different research centres in the capital of Spain.

The new Materials Science Institute of Madrid was created with the objective of building synergies, not only among these researchers, but also with the Spanish university community. That is why the building, which has housed the ICMM since 1996, was placed in the campus of the Universidad Autónoma de Madrid (UAM) in the northern district of the capital, an area with many companies that are involved in the hi-tech sectors.

The initial project proved to be successful, and 25 years later the ICMM is the largest institute of the 13 centres in the Materials Science and Technology Area of CSIC. More than 400 people (43% women) work at the ICMM (107 are permanent staff scientists), covering a broad range of materials science topics: from fundamental solid state physics studies to the use of advanced synthesis methods in chemistry for the production of novel materials, the analysis of structures with low dimensionality and the development



of advanced materials with applications in energy, biomedicine, photonics and several technologies used in the information society.

Research at the frontier of materials science

This large range of activities is organised into seven research lines, which are focused on facing the challenges of the application of materials in several fields. The Photonic Materials line explores the development of new materials and structures in the search for new properties and functionalities in photonics. Members of the Materials for the Information Technologies direct their research towards new, knowledge-based materials and heterostructures for applications in devices such as computer memories, sensors and actuators, magnetoelectronic and optoelectronic devices.

Concerning the Energy, Environment and Sustainable Technologies line the objective is the fundamental study of the synthesis and the structural and functional characteristics of materials, which will lead to the design and

development of prototypes of electrochemical devices for energy generation (fuel cells) and for energy storage of electric energy (supercapacitors and batteries). The ICMM also possess a line dealing with biomaterials and bio-inspired materials that includes studies into new ceramic-metal composites for improved implants, the preparation of advanced colloids for the detection and treatment of tumours and also the use of bio-inspired routes for the preparation of functional materials.

The processes that take place at surfaces, thin films and low-dimensional systems are the topics studied in the Nanostructures, Surfaces and Coatings line. The combination of applied technological issues with fundamental research, advanced characterisation tools and theoretical methods makes this research line key to developments in the areas of nanoscience and nanotechnology.

In the New Architectures in Materials Chemistry line, ICMM researchers design chemical strategies to develop new multifunctional, supramolecular,

nanostructured hybrid, biohybrid and porous materials for a plethora of applications with the aim of eventually transferring them to industry. The studies of new properties of novel materials and devices from a theoretical point of view are carried out in the Theory and Simulation of Materials line. The aim is to understand the experimental data and the generation of predictions in a variety of topics: strongly correlated electron materials, out of equilibrium and nonlinear phenomena, soft condensed matter and low dimensional systems, nanostructures and mesoscopic systems.

Aiming at excellence

The concentration of highly qualified personnel and the state-of-the-art instrumentation in one centre has allowed a more efficient management of the resources leading to outstanding scientific results: between 300 and 350 scientific papers are published every year in high ranked journals (with an average impact factor above three). In some cases, this production has been impressive, and, for instance, three of the top 10 most cited Spanish all-time papers (in materials science related disciplines) are authored by ICMM researchers. One of them is the result of the work carried out in ICMM into the fundamentals of graphene by a world renowned expert, Professor F Guinea, who maintains strong collaboration with A K Geim and K Novoselov, 2010 Physics Nobel Prize awardees for their experimental studies on this two-dimensional material.

The ICMM also attracts much attention for the quality of its research in other areas, as it has happened in one of the most prestigious journals of this field, 'Advanced Materials', which this year is publishing a special issue on materials science in Madrid. The ICMM develops its activity in strong connection with other top-level materials science research institutes, being a member of the high-class World Materials Research Institutes Forum.



This international linkage also makes the ICMM an attractive option for foreign PhD students and researchers.

At the moment there are six foreign researchers among the permanent scientists and around 40 PhD students from abroad at ICMM. Although the ICMM is not involved in undergraduate education, it has an attractive programme of postgraduate courses. Through agreements with the universities, some of these courses are included as part of the Master's. Moreover, ICMM maintains close connections with society through the outreach programme, which continuously designs activities (conferences, guided tours, contests, exhibitions) aimed at the scientific spreading of the new topics involved in current research on materials.

The future ahead

The ICMM actively interacts with those centres included within the recently awarded International Campus of Excellence UAM+CSIC. The coordination of the specialised scientific services scattered across different CSIC institutes and faculties is a major task in which the ICMM has become one of the leading institutions. Improved management of

these resources is essential to remain competitive and to fulfil the objectives proposed in its present Action Plan 2010-2013.

Funding is, of course, a key factor. For a research centre mainly focused on basic science, when national and European agencies prioritise funding of applied research aimed at industry, ICMM faces the challenge of reinforcing technology transfer to the private sector. The ICMM has already filed successful patents that are now in production lines under licensing. Recently, 25% of the patents portfolio presented by CSIC in an international fair on nanotechnology in Japan came from ICMM. But there is still much to do to improve the level of technology transfer, which must take advantage of the high-quality basic science that the ICMM already produces, with the objective to prolong this success story in the years to come.



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