

The creation of a new Institute of Research on Nanoscience and Nanotechnology (CIN2,CSIC-ICN)*

1. Introduction

Nanoscience and Nanotechnology (N&N) are new approaches to research and development that aim to control the fundamental structure and behaviour of matter at the level of atoms and molecules. These fields open up the possibility of understanding new phenomena and producing new properties that can be utilised at the micro- and macro-scale. The range of materials to be studied spans from the atomic scale, molecular or macromolecular compounds, to nanoparticles, nanowires and in general, nanostructured materials.

Besides, nanoscience is often referred to as “horizontal” knowledge, since it can pervade virtually all technological sectors. It often brings together different areas of science and benefits from an interdisciplinary approach and is expected to lead to innovations that can contribute towards addressing many of the problems facing today’s society (Communication from the European Commission). Medical applications, information technologies, energy production and storage, material science, manufacturing at the nanoscale, instrumentation for the study of the properties of matter at the nanoscale, food, water and environmental research, security are some examples of different fields of application.

2. Nanotechnology R&D in Spain

A comparative funding levels between EU, Japan, USA and other countries on a per-capita basis in 2003 (1€=1\$) indicates that Spain shows the lowest mark, 0.04€ per capita. In Catalonia the situation is slightly better but far from the standards.

The existence of a good number of groups in Spain working on techniques and methodologies related with N&N cannot hide the low support of the State to this important field of research. Just in the last three years a first call totally devoted to N&N has been proposed. Nevertheless, at present it is not clear the continuity of this call. Due to this specific action, a small increase in the funds per capita devoted to N&N has forcibly increased in 2005 although the percentage will remain unfortunately low.

3. Opportunity

There are several reasons supporting this fact: a) the political support from the State and the Region b) the possibility to create a new and agile management of the Research Centre shared between those two actors; CIN2 will be a mix institution c) support of the Autonomous University of Barcelona (UAB) permitting and supporting actively the construction of the CIN2 building in its own Campus in Bellaterra by a cession of an adequate ground: this institution will be also included in the management of CIN2.

The novelty in the CIN2 management lies upon the fact that two partners (Generalitat de Catalunya–Regional representative- and UAB) of this key action are grouped in a Research Institute of recent creation that has the legal status of a Foundation named Fundació Privada Institut Català de Nanotecnology (ICN). At present, the ICN has an annual budget which permits to hire scientific researchers and also to cover the running costs of the Institute. The other partner is the Consejo Superior de Investigaciones Científicas (CSIC), the Spanish Research Council —State representative—, develops its activities in a large number of scientific and technological areas all around Spain. In particular, an important number of Institutes have been created by the CSIC in the Campus of the UAB. CSIC and ICN decided to work together in this project and they are both the real partners constituting the new Research Centre, the CIN2. The initial scientific equipment needed for the taking off of the CIN2 will be funded by ICN and the building that will host the new Research Centre will be financed by CSIC. After the initial period of installation a consolidated budgeted support-



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ed for both partners will be agreed supporting its activities. The flexibility in the formalization of new contracts at all levels, from pre-doctoral positions to Professor of Research, is guaranteed by the Foundation. The Foundation constitutes in itself a formidable help for recruiting scientist and technicians. Although this opportunity is completely open for the Research Centre, the Direction of CIN2 wants to use it in a carefully way by respecting, if possible, a certain parity of stable positions between ICN and CSIC. Recruitment of outstanding scientists has already been done using this way. A permanent position can also be obtained after the application to the annual open call (ICREA programme) of the Catalan Government or reaching a CSIC staff positions.

Once this action has been activated the further step will consist in the creation of a Nanocluster in the Campus of the UAB. CSIC Institutes such as Institut de Ciència de Materials de Barcelona (ICMAB), Institut de Microelectrònica de Barcelona (IMB-CNM), MATGAS (Agrupación de interés económico between Air Products, CSIC, UAB), selected members of Departments of the UAB, scientific and technical facilities and CIN2 will constitute a Nanocluster selecting a general manager, sharing scientific services and creating virtual platforms of research which will increase the interdisciplinary needed in a research of excellence as foreseen to be developed in the Nanocluster. Besides, some additional activities to be developed by the cluster could be: a) launch a business development initiatives to foster investment in innovation involving venture capital, institutional investors, regional development initiatives; b) promote an education, training and professional programme, through the development of a master plan for education and information; c) introduce a strategy for building international co-operation; d) establish a centre for the consolidation and dissemination of information.

CIN2 will also establish special relationships with the synchrotron radiation facility, ALBA, which is built up in the UAB Campus by sharing man power, workshops and determining a common topic of research to both organisms: nanotechnology and synchrotron radiation. One of the goals of the collaboration will be to design a beam line where new and not routinely experiments will be conceived. Also, we will work towards establishing close cooperation links with the recently established Barcelona Supercomputing Center (BSC), in order to ensure that CIN2 researchers will benefit from the Supercomputing facilities and research environment provided by BSC.

4. Internal structure of the Centre d'Investigació en Nanociència i Nanotecnologia, CIN2 (CSIC-ICN)

The unit of research of the Institute is constituted of a "cell" grouping seven scientists who develop a line of research. The unit is lead by a senior/staff researcher with two post doctoral positions reporting to him. Each post-doctoral position is supported by two pre-doctoral positions. Several "cells" form a Department.

By now, the vertical structuring of the Institute is performed through the creation of three different Departments mainly devoted to Nanoscience:

- 1) Characterization of electronic, magnetic, vibrational and structural properties of molecular materials at nanometric scale. Theory and simulation at nanometric scale. Lines of research: a) Theory of non-equilibrium electronic processes in the nanoscale b) Molecular systems investigated with scanning probe microscopies c) Atomic-scale Magnetism
- 2) Synthesis of inorganic, organic and hybrid nanostructured materials. Lines of research: a) Molecular magnets at surfaces for nanoscopic devices b) Nanoparticles laboratory c) Materials for energy storage and conversion
- 3) Physical properties of the nanostructures. Lines of research: a) Tailoring magnetization reversal in magnetic nanostructures by exchange bias b) Nanoionics, ion conducting nanocomposite thin films and multilayers c) Nano-optics: Nanoscale Optical Microscopy/ Spectroscopy and Light Manipulation d) Quantum Transport in Carbon Nanotubes and a fourth Department devoted rather to Nanotechnology:
- 4) Nanobiosensing. Lines of research: a) Nanotechnology-based biosensors b) Nanobiosensors and molecular nanobiophysics group

A parallel structuring will be performed by selecting some outputs close to pure Nanotechnology giving rise to two technological departments. It has been collected in the first pages of this paper the main fields of application of the Nanotechnology following a Communication of the European Commission. Taking into account the fact that CIN2 is inserted in a civil society which has very defined boundary conditions with respect its innovation capabilities, we have selected, by now, energy production and storage as the main issue. The selection of this departments will enable the CIN2 to develop applied Nanotechnology close to industrial needs and will prepare the creation of "spin offs" linked to the Institute. The structure of the Technological Departments should be close to the "cell" defined before although they should be more adaptable to the rapid changes occurring in the nanotechnology and also should be prepared to interchange man power with the hypothetical "spin off" created in collaboration with CIN2.

5. General strategy

As a general strategy of management the Direction supports the following issues:

- a) The size of the research cell is not absolutely static. As a function of the necessities, the size can be modulated (especially in the chemistry groups and in the "outputs" area) but this norm will be respected as much as we can in order to avoid uncontrolled growth of some lines of research and/or Departments that can alter the delicate balance that we want to establish and can lead to a rapid saturation of the Institute. From the point of view of future capabilities and implementation of new lines of research, room and man-power saturation should be avoided.

- b) In each cell of research just one post-doctoral position (as a maximum) could get a permanent position. Rotation of post-doctoral and pre-doctoral students will be strongly supported.
- c) Once a research line is created, the Research Centre will provide a basal budget to the research unit to cover the needs for small scientific equipment, consumables and travel expenses during the firsts years in order to facilitate in the shortest possible period of time the scientific background to competitively apply to domestic and international calls for funding research projects.
- d) In less than two years from now (time consumed in the building construction, purchase of the scientific equipment.), indicative flags or labels defining the main activity of the Institute should be determined. We expect to firmly establish: two in Nanoscience and one in Nanotechnology.