
Preface: Nanotechnology in Spain

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Biographical notes: Pedro A. Serena has been a Researcher at the Madrid Materials Science Institute (ICMM-CSIC) since 1997. He received his PhD from the Universidad Autónoma de Madrid in 1990 and worked at the IBM Zurich Laboratory during 1990–1991. He was Associate Professor at the Universidad Autónoma de Madrid (1992–1995) and postdoctoral researcher at the CSIC (1995–1997). His main research activity focuses on the study of electronic transport through nanostructures, Monte Carlo simulations of magnetic properties, and *ab initio* calculations. He is coauthor of more than 50 papers, has been involved in more than 15 national and international research projects, and has coordinated ‘Nanociencia’ (2000–2004) and ‘NanoSpain’ Research Networks (2001–2004).

Nanotechnology, without the shadow of a doubt, constitutes a major driving force in basic as well as in applied science, and provides the foundation of a mid-term technological revolution. This revolution will modify industrial manufacturing procedures, enabling sustainable and competitive growth, and will increase the amount, quality and average life span of final products we will find in our stores. This revolution will be, perhaps, slow but continuous, and in a couple of decades we will see its implications and effects on the society. Governments, institutions, private companies, and financial entities have understood that the support of this new scientific and technologic paradigm is a mandatory task and, subsequently, a huge amount of resources have been earmarked for its development and implantation. In particular, USA, Japan, Korea, Canada, Germany, France, and the European Union (EU) have established specific programmes for the development of nanotechnology from the late 1990s.

The particular situation of nanotechnology in Spain, when compared to that found in other developed countries, is similar to that of other research areas and topics. Spain invests approximately 1.1% of its gross national product (GDP) in R&D, the relative number of researchers per 10,000 inhabitants does not reach the EU average, and there is a deficit of competitive first-line research centres similar to those established across Germany, France or UK several decades ago. Although economic efforts devoted in Spain to promote R&D multiplied by five (in terms of the percentage of the GDP) during the last 25 years, we are still far from the level of most developed countries, where science has been considered during the last two centuries a key factor for the industrial and social development. Within the same time period, different Spanish Governments tried to fight, with relative success, against a traditional lack of interest in science and

technology within the Spanish society. Since science was not considered a priority, it is easy to understand the cause of some delay between Spain's scientific policies and those taking place in neighbouring European countries. In particular, the first general initiative concerning the support of nanotechnology was announced at the end of 2003, included within the Spanish R&D National Programme for the period 2004–2007. This three year Strategic Programme in Nanotechnology will distribute 16 M\$ per year to competitive R&D projects where basic, applied and industrial R&D groups must join their efforts in well-defined mid-term objectives. The first series of projects will start in 2005, and, therefore, it is too early to determine the success and real impact of this programme.

Spanish scientists realised very quickly that nanotechnology and nanoscience will become predominant areas in future R&D. In particular, Spanish researchers launched two research networks: 'Nanociencia (Nanoscience)', where more than 150 young researchers formed in national and foreign groups exchanged ideas and experiences, establishing fruitful scientific collaborations; and 'NanoSpain', a huge network formed, at the present time, by more than 140 research groups and laboratories from universities, government institutions and industry. More information about NanoSpain can be found at <http://www.nanospain.org/>. A major objective of NanoSpain is to ensure that the Spanish industry and R&D facilities play a key role in this field, allowing the exchange of ideas, provide information either from universities or from companies. In particular, the Strategic Programme in Nanotechnology was inspired by the NanoSpain network. In addition to this networking activity, other initiatives have flourished in Spain during the last five years in order to establish a solid scientific and technological structure, which is able of competing within the European Research Area (ERA). The creation of institutes and centres in Barcelona, Zaragoza, Oviedo, as well as the organisation of the series of conferences 'Trends in Nanotechnology' (2000–2004) are examples of these initiatives.

The present special issue of the *International Journal of Nanotechnology* is devoted to describe the present status of nanotechnology in Spain. It is clear that it is not feasible to reflect (in only one special issue) the research activity of many groups developing R&D activities in nanotechnology. Only a small fraction of such groups has been chosen to represent them. The contributions included in this special issue mainly correspond to several talks and seminars presented in two different meetings of the Nanociencia Network held in Barcelona (2002) and Oviedo (2003). These contributions cover a wide range of topics: advanced magnetic nanomaterials; magnetic and electron transport properties of nanoparticles; production, characterisation and modelling of carbon nanotubes; electronic transport in quantum dots; mesoporous systems and zeolites and their role in nanochemistry; and the use of 'nanotools' to address the study of different biological systems. This variety reflects the enormous potential of Spanish scientists in several research fields. However, a successful transfer from this potential into a reality, which is able to contribute with a significant weight in the coming industrial revolution, will depend on the explicit and continuous support of basic and applied aspects of nanotechnology, through adequate scientific policies and the involvement of Spanish industry.