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NANOSCIENCE IN THE
BASQUE COUNTRY:

THE BIG CHALLENGE OF THE SMALL

Nanotechnology is currently accepted as one of the driving forces behind economic growth in the 21st Century, apart from being one of the key factors of a sustainability that cannot fail to mark the future development of humanity. The road ahead is long and uphill: one needs to understand new phenomena and master the manipulation of matter on a nanometer scale; one also needs to be capable of designing and creating materials, devices, and systems through controlling matter at that scale. Researching the small and extracting technological performance that can be converted into new products and more efficient processes, whilst at the same time being sustainable, is a huge challenge. This challenge is

currently being taken on by the most advanced countries in the world and by those that expect to occupy a prominent place in the future. There is no doubt that this represents a big challenge for a small but successful country, the Basque Country, which is currently aiming at becoming an innovation reference in Europe.

The Nanoscience Cooperative Research Center nanoGUNE Consolider has been created in the framework of two important initiatives launched by the Department of Industry of the Basque Government. The first is the so-called nanoBasque Strategy, designed for the development of a new economy sector in the Basque Country that would be enabled by nanotechnology.



The second is a network of Cooperative Research Centers, launched in order to: (i) create an effective framework of cooperation in strategic research areas in the Basque Country, (ii) strengthen interdisciplinary basic and applied world-class research in those areas, and (iii) provide technology transfer to the industrial environment. NanoGUNE is also a Consolider center, which means that its creation has been partially funded by the Spanish Consolider program, aimed at big projects at the frontiers of science performed by consolidated research groups that are expected to lead Spanish science in a given field. NanoGUNE is a new center, with legal personality, created in 2006 with the mission of performing world-class nanoscience research for the competitive growth of the Basque Country.

As well as other cooperative research centers in the Basque Country, nanoGUNE is composed of a newly created physical section, the core of the center, and a sometimes called virtual section. The newly created physical section, with its own infrastructures and researchers, is oriented to open new areas of strategic research. In the virtual section, cooperation is fostered among existing research groups at the Donostia International Physics Center in San Sebastian, the University of the Basque Country, Technological Centers, and also industry at some point. Our activities will include world-class research in nanoscience and nanotechnology, the generation of new infrastructures, the promotion of high-level training, international cooperation, communication and outreach, technology transfer, and the promotion of nanotechnology as an enabling tool that should increase the competitiveness of the Basque industry.

NanoGUNE's research activity will be initially implemented within the following major areas of strategic research: (i) nanomagnetism, (ii) nano-optics, (iii) self-assembly, (iv) nanobiotechnology, and (v) nanodevices. Our nanomagnetism laboratory focuses primarily on the fabrication and characterization of thin layers and multilayered materials with an impact on information technologies. The nanooptics laboratory focuses on near-field optical microscopy and characterization, instrumental development, and applications in materials science (including semiconductor technology and biology) and photonics (including optical antennas and metamaterials).

The self-assembly laboratory focuses on the synthesis and chemical functionalization of nanostructures. The nanobiotechnology laboratory focuses primarily on the use of nanocrystals and quantum dots for biomedical applications. And, finally, the nanodevices laboratory focuses on carbon-based spintronics, non-volatile memory devices, hybrid multifunctional devices, and complex materials including strongly correlated oxides.

Our group leaders were selected with the help of our international advisory committee, after a careful selection process (including a series of seminars and interviews) among candidates from all over the world. The selected candidates, already with us, were Andreas Berger (who also acts as Research Director), Rainer Hillenbrand, Alexander Bittner, Igor Nabiev, and Luis Hueso, who came from Hitachi in the USA, the Max Planck in Munich and Stuttgart (Germany), the University of Reims (France), and the University of Leeds (UK), respectively. We already have a critical mass of 25 researchers (including graduate students, post-docs, and technicians), with the expectation that in 5-10 years the total number of researchers might approach 100.

Progress in nanoscience research is only possible if one can actually fabricate nanoscale materials and measure their properties on the nanometer scale and with sufficiently high sensitivity. Thus, one key challenge was to build a unique infrastructure, free of electromagnetic interference (EMI), with an ultralow level of vibration and acoustical noise, and ultra-clean rooms available. In order to achieve this goal and host state-of-the-art facilities (including e-beam lithography, scanning-tunneling, atomic-force, nearfield-optical and high-resolution electron microscopes, and a dual-beam focused ion beam) for nanoscience research, a complex working team was put together, with experienced architects and engineers, and vibration, EMI, and clean-room consultants. The nanoGUNE building, located at the Campus of Ibaeta of the University of the Basque Country in San Sebastian, was inaugurated officially in January 2009. This is a building of 6,200 m² that includes 15 ultra-sensitive laboratories in the basement and a cleanroom of about 300 m² for nanofabrication.

Last but not least, nanoGUNE is a research center committed to the industrial fabric of the Basque Country. Hence, nanoGUNE's research activity is oriented, in particular, to increase the competitiveness of existing companies and enable the creation of new companies. To achieve this objective, the research performed at nanoGUNE will be constantly assessed to pursue potential applications and an effective transfer to the field of technological development.

We will compete and collaborate with many other research laboratories around the world until we find the space that will allow us to offer something different. When we do so, we will be contributing with our small size to creating the necessary conditions for humanity to benefit from a wide range of nanotechnologies. This is the big challenge of the small.

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