

NANOTECHNOLOGY IN ITALY

AIRI/Nanotec IT

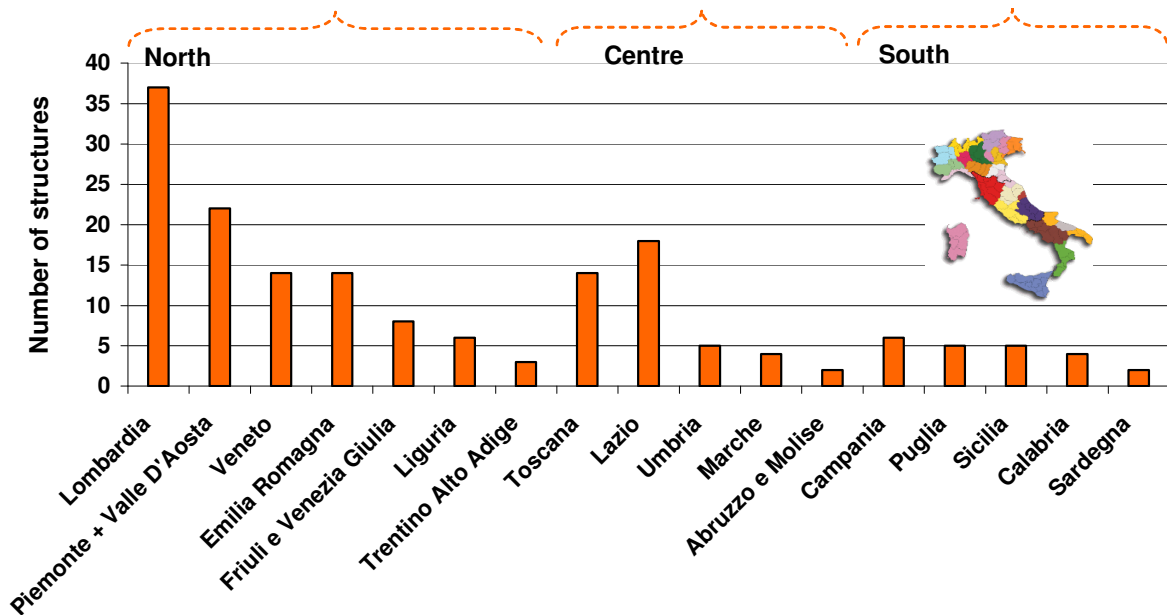
General overview

The activity in nanotechnology is in Italy rather intense and growing steadily. The “2nd Census of Italian Nanotechnology”, carried out by AIRI/Nanotec IT in 2006 pointed out the presence of some 180 structures doing R&D in this field. This number has since further increased and now the structures that in Italy are involved in nanotechnology are more than 200 (a new edition of the Census will be published in 2010). Around 55% refer to public institutions and the remaining 45% to private enterprises. In 2004, at the time of the 1st AIRI/Nanotec IT Census, these structures were 120. Private enterprises were the principal responsible of the increase.

The spectrum of the R&D activity is a rather ample and the objectives do not differ much when one compares industry and public research. Structural and functional materials, biotech and life sciences, nanoelectronics & optics (ICT), instrumentation/equipments, chemical-related products and processes are the fields in which the research is essentially focused.

In the period 2002–2005 the structures reported in the 2^o Census, produced some 7638 scientific publications (most of them on International journals) and 332 patents. Around 60% are from industry and 40% from public research.

The activity is widely distributed across the national territory and usually nested around the biggest university present in the various regions. In Figure 1 it's reported the number of research structures (public and private) present in each region that answered the census. It turns out that the major concentration is in the northern-central part of the Country, with Lombardia showing the highest concentration, with more than 20% of the structures and 30% of the people reported by the census. It must, however, be stressed that also the regions with a lower number of structures, do not play a secondary role. The structures present there can, in fact, boast a high level of competences and equipments and, often, good critical mass.



Geographical distribution of research structures active in nanotechnology

Public funding is the main driver of the action though a specific initiative for nanotechnology does not yet exist in Italy as in other countries, such as in US. Nevertheless nanotechnology is among the priorities of the National Program for Research (PNR).

Several initiatives have been taken in the last years to promote R&D in the field and to improve the use of the resources.

In the public sector, research groups, labs, departments, institutes, have been grouped together to reduce fragmentation and coordinate the activities. "Reference Centres" (Tab1) focused on nanotechnology have been created at various Universities with the support of the Ministry for University and Research (MUR).

Educational initiatives aimed to nanotechnology have been activated in the past years at various Italian Universities. Their number is increasing. Most of them offer different kinds of post graduate or PhD courses, sometime relay on international collaboration and often host both Italian and foreign students. Private enterprises are sometimes contributing to the educational initiatives by hosting/offering thesis work or stages, workshops.



Tab 1: Reference Centres for Nanotechnology

- Center for Nanostructured Surfaces and Interfaces (**NIS**)- **University of Torino**
- Laboratory of Electrochemical Miniaturised Technologies for Analysis and Research (**LATEMAR**)- **Polytechnic of Torino**
- Center of Engineering of Nanostructured Materials and Surfaces (**NEMAS**)- **Polytechnic of Milano**
- Interdisciplinary Centre for Materials and Nanostructured Interfaces (**CIMAINA**)- **University of Milano**
- Center for Preparation, Development and Characterization of Nanostructured Materials and Surfaces (**CENMAT**)-**University of Trieste**
- Center for Nanostructured Innovative Materials for Chemical, Physical and Biomedical Application (**CEMIN**)-**University of Perugia**
- Center for the Preparation and Treatment of Organic Material at Nano-scale for Application in Photonics, Optoelectronics, Transformation and Separation (**CEMIF.CAL**)-**University of Calabria**

Among the high tech clusters (“technological districts”) created in some regions with the support of MUR to favour technological development in specific advanced sectors, those having nanotechnology in their mission are increasing. At the moment there 6 of them (Table 2).

Region	Area/s of research	Managing company ¹
Veneto	Nanotechnology applied to materials	Veneto Nanotech S.c.p.a
Friuli Venezia Giulia	Nano-Biotechnology	Center for Molecular Biomedicine CBM S.c.r.l.
Campania	Polymeric and Composite Materials	District for Polymer and Composite Materials Engineering and Structures IMAST S.c.a.r.l.
Puglia	Nanoscience, Bioscience, Infoscience	DHitech S.c.a.r.l.
Umbria	Special metal materials, Micro and nanotechnologies, mechatronics	DTU - Umbria Region

¹ Public institutions and private enterprises participate in the managing company

Veneto Nanotech is focused exclusively on nanotechnology. In 2005 it has been activated in the district a nanofabrication facility, NanoFab, and in 2007 ECSIN, European Centre for the Sustainable Impact of Nanotechnology.

The players

Public Institutions

All major public research organisations (CNR/INFM, INSTM, INFN, ENEA) and University play a pivotal role to promote nanotechnology in the Country. As said, to them belong roughly 55% of the structures active in the field.

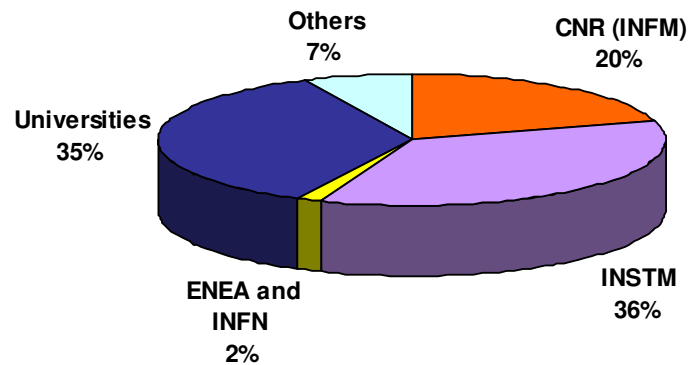


Figure 1. Distribution (%) of structures among the Institutions considered

At the **National Research Council (CNR)**, into which in 2004 merged the National Institute of the Structure of Matter (INFM), nanotechnology has gained progressively room. R&D activity covers now all the research areas mentioned above and this commitment has been paralleled with initiatives aimed to focus and reorganise resources toward this sector. From 2006 most of the activity at CNR in nanotechnology refers mostly to two newly created departments: the Department of Materials and Devices and the Department of Molecular Design, to which refer labs located in different parts of the Country (*reference website: www.cnr.it/istituti/Peraretematiche_eng.html*).

Within the **Italian Institute of Technology (IIT)** it has been activated a “Nanobiotech facility” devoted to research in the fields of nanochemistry, nanofabrication, nanophysics and computer imaging.. The Institute is part of a network of research laboratories on nanotechnology, also including the “National Nanotechnology Lab” (CNR-NNL) and the “National Enterprise for nanoScience and nanoTechnology” (CNR-NEST), Scuola Superiore Sant’Anna di Pisa, active in the areas of nanomedicine, smart materials, energy production and storage (*reference website: www.iit.it*).

The **Italian Interuniversity Consortium on Materials Science and Technology (INSTM)** coordinates Research Units located in 44 Italian Universities and its interest is mainly related to chemical sciences.

In 2004, 9 Reference Centers (INSTM–RC) have been created within the Consortium to make more effective the activity. These Centers connect often research units active at different Universities. Nanotechnology represents a primary (sometime exclusive) objective of their research (*reference website: <http://87.41.172/instm/index.php?id=1,6>*).

Most of the action in nanotechnology at the University refers to INSTM and CNR, but the Census has pinpointed also more than **40 University structures** active in nanotechnology not linked to the above two institutions.

These structures, as shown in Figure 4, represent the 35% of the total and their activity focus on the physics material science, engineering (in particular electronics),

biotechnology/bioengineering, chemistry, pharmaceutical sciences and, in a limited number of cases, mechanics.

The **National Institute of Nuclear Physics** (INFN) and the **National Body for Energy, Environment and New Technologies** (ENEA) are also involved in nanotechnology. As shown by the Census, however, their involvement is at present less intense respect to the Institutions just described.

At ENEA the R&D activity is carried out within the Department Of Advanced Physical Technologies And New Materials (FIM), while at INFN it is concentrated at Frascati National Laboratories (LNF).

Besides the above said Institutions there also other organisations involved in nanotechnology, in particular on the Environmental, Health and Safety field. They are research centres and national agencies such as the **Italian Institute of Occupational Safety and Prevention** (ISPESL), the **Italian Health Institute** (ISS), the **Italian Workers' Compensation Authority** (INAIL), and the **National Institute of Metrological Research** (INRIM).

Industry

During the past few years the number of Italian enterprises dealing with nanotechnology have steadily increased. The last update of the Census have identified 86 companies with activity in this field. A strong increase from the 1st Census in 2004, when answered only 20 private enterprises.

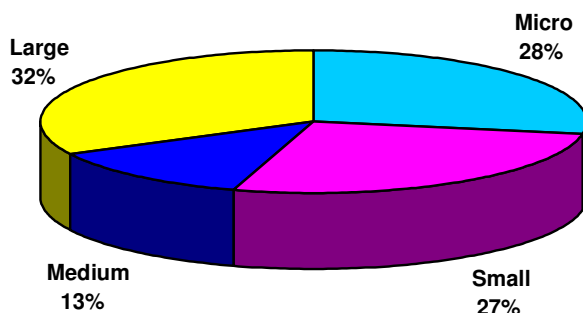


Figure 2. Number of structures (%) with reference to the size of the company

As shown in Figure 3, SMEs, which account for most of the increase, represent about 70% of the total. Quite many of them are micro (less than 10 people).

Quantitatively the effort is concentrated within the big companies. They include well known National players such as ENI (energy, catalysis); FIAT Research Centre-CRF, Brembo, Pirelli (automotive); Bracco Imaging, Fidia Advanced Biopolymers (biomed); Colorobbia, Ferrania (materials); Center for Material Science-CSM (materials); CTG-Italcementi (construction); Finmeccanica Group (aerospace, defence) which has organized its nanotech activities into the Nanomaterials and Nanotechnology Focus Group bringing together a number of its companies (Alenia Aeronautica, MBDA, Thales Alenia Space, Elsag Datamat, Selex Sistemi Integrati, Selex Communications); Saes Getters (vacuum technology); STMicroelectronics, Numonyx (semiconductors); Basell Polyolefins, Mascioni, Saati (textiles), D'Apollonia (technology services).

There are also numerous of SMEs whose number has increased in the last years and they have an important to spread the application of this emerging technology within the industrial fabric. To name a few, we can mention: Ape Research, Avago Technologies, Eontych, Organic Spintronics, Silicon Biosystems, Microla, BilCare Technologies; IM-Innovative Materials, MBN, Xenia

materials (nanomaterials); Grado Zero Espace, SmarTex, MecTex (textiles), Nanosurfaces, Kenosistec, Plasma Solutions (surface treatments); Finceramica, Tethis, Xeptagen, Nanovector; Mavisud, Cyanagen (biomed), Centro Ricerche Plast Optica (lighting), Trustech (technology services),

Large enterprises are normally more focused than SMEs as their research is aiming in first place at their core business. SMEs, on the contrary, look at a variety of potential applications, exploiting the multi-sectoral character of nanotechnology. Instrumentation, is particular in fashion, but SME result rather active also in the medical field.

In conclusion, the Nanotec IT censuses have made evident that R&D activity in nanoscience and nanotechnology is in Italy quite intense and involves both public research and industry. Public research is still prevailing, but the commitment of private enterprises is increasing and it refers to important industrial sectors. This trend is going to continue.

AIRI/Nanotec IT as contact point

A large part of the organizations involved in nanotechnology are members of AIRI/Nanotec IT (Italian Centre for Nanotechnology). AIRI/Nanotec IT is available for any information or support regarding R&D collaboration and partnerships with Italian organisations active in the field.

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