The Department of Physical Sciences and Technologies of Matter (DSFTM) of CNR coordinates 11 Institutes, spread all over the national territory in 56 branches that host 750 researchers. A comparable number of associated scientists from Universities participates in the activities. DSFTM institutes carry out research spanning from fundamental topics, at the frontier of knowledge, to applicative ones, in response to societal challenges and in agreement with the goals of Horizon 2020 at European level: Environment, Aerospace, Agri-food, Life Sciences, Communications, Information processing and storage, Cultural Heritage conservation, Energy, Health and Wellness.

In this framework, Key Enabling Technologies such as nanotechnology, micro and nanoelectronics, advanced materials, photonics, biotechnology, are the common base to carry on research, representing a source of innovation pervading all fields of activity.

**KEY ENABLING TECHNOLOGIES AT DSFTM**

### Nanotechnology

Quoting the European Commission, “Nanotechnology is an umbrella term that covers the design, characterisation, production and application of structures, devices and systems by controlling shape and size at nanometre scale”.

**Keywords**: nanostructures, nanodevices, 2D materials, nanomedicine, nanocomposites

### Micro and Nanoelectronics

Deal with semiconductor components and highly miniaturised electronic subsystems and their integration in larger products and systems.

**Keywords**: semiconductors, sensors, biosensors, magnetoelectronics, flexible electronics, Microsystems, advanced photovoltaics

### Advanced Materials

Lead both to new reduced cost substitutes to existing materials and to new higher added-value products and services.

**Keywords**: graphene, silicene, new superconductors, hybrid materials, organic architectures, nanostructures, highly cohercitive nanomaterials, oxides, ferroelectric crystals

### Lasers and Photonics

Are the sciences and technologies of light, its generation, detection, management.

**Keywords**: quantum cascade laser, coherent sources, non-linear optics, new spectral ranges, biophotonics, new laser types for energy, spectroscopy, Bose-Einstein condensates, applications in biomedicine, cultural heritage, environment

### Biotechnology

Deals with biological systems and living organisms, interfacing and using them to develop useful products. Nanobiotechnology applies nanotools to medical /biological problems.

**Keywords**: lab-on-chips, biosensors, nanotoxicology, drug delivery, tissue engineering, optical tweezers, microfluidics
DSFTM manages more than **200 patents**, taking care of **licensing** and registration.

DSFTM patents include the invention of sophisticated processes for telecommunications, semiconductor industries, and also innovative products that can have a direct impact on our lives, such as instruments for medical diagnostics or for food control. Here are some numbers and some examples.

In recent years, DSFTM has generated several spin-off companies. Presently, 7 of them are active and 3 are mainly involved in KETs:

- **Soft Material & Technologies S.r.l.** - Micro and nanotechnologies for the production of nano-structured soft materials
- **ThunderNIl S.r.l.** - Tools for NanoImprinting Lithography with unprecedented throughputs
- **Columbus Superconductors S.p.A.** - Superconducting wires by magnesium diboride technology

Method for the controlled distribution of pico- or nano-volumes of a liquid: WO 2010122592 A1


Optical method for the automated gas pressure and concentration measurement inside sealed containers (with UNIPD, licensed to LPro): WO 2008053507 A2

Microwave surgical device: interstitial probe for ablation of solid tumors (licensed to HS Hospital Service): WO204037202 (A1) and WO02061880 (A2)

Influence of the entire CNR portfolio: 25% and 66% of the CNR income derived from patents.
DSFTM Institutes own and operate a remarkable number of high-technology facilities and laboratories: they form a unique multi-site network that can support industries and small companies, providing access to technology, know-how and services. The map shows the location of the major facilities (smaller ones may be also available elsewhere).

For nanotechnology, micro-nanoelectronics, advanced materials
Cleanrooms host equipment for thin film technology, lithography, diagnostics, material growth.....Find the one closer to you!

Growth/deposition: physical and chemical deposition, MBE, atomic layer deposition, chemical synthesis, nanostructured materials, nano-wires, nanoparticles

Characterization: high resolution electron microscopy (TEM, SEM, STM), X-Ray, electrical measurements and optical spectroscopies, Raman spectroscopy, photoluminescence

Processes: etching, micro-nano machining, thermal treatments, wafer bonding, wet processes

Lithography: UV, deep UV, electron beam, ion beam, X-Ray, nanoImprinting, laser interference

DSFTM institutes guarantee access to international infrastructures for nanotechnology, micro-nanoelectronic, advanced materials and biotechnology research, through beamlines at Elettra (Trieste, IT) and ESRF (Grenoble, F) synchrotron facilities, ILL (Grenoble, F) and ISIS (Oxford, UK) neutron sources.....Find the one which suits you best!
Merge equipment and tools typical of biochemistry, biophysics and molecular biology laboratories. Nanotechnology is often needed in order to manipulate tiny living things.

Advanced laser sources (mid-infrared and terahertz quantum cascade lasers, high-brightness fiber lasers, femtosecond lasers); photonics detectors; sensors; nonlinear optics; quantum optics

Manufacturing of optical elements, laser micro-machining and macro-machining; laser lithography; optical fibers; optical measurements and testing

Lasers and photonics for food, cultural heritage, health care (mammography, ophthalmology, tissue analysis, biophotonics); lasers for ICT, quantum information

Preparation of biological samples (biomolecules, supramolecular structures, lipid structures, microorganisms, cells, tissues)

Characterization and manipulation (scanning probe microscopies, electrophoresis, spectroscopies, electrophysiology, crystallography)

WHAT WE OFFER:

BE A CNR PARTNER! CONTACT DSFTM

DSFTM Institutes have a long tradition of collaboration with industries and enterprises. This has resulted in a huge number of partnerships in projects funded by public organizations (Ministries, regions, etc.), European Community, consortia.... Here are some of our industrial partners. Join them! Contact DSFTM or its Institutes!

WHAT WE OFFER: