Nanotechnology Lab LTFN

Lab for Thin Films - Nanobiomaterials
Nanosystems & Nanometrology

www.ltfn.gr

2019
The Nanotechnology Lab LTFN, established in 1991, at the Aristotle University of Thessaloniki (AUTH), is an internationally acknowledged specialist in Organic Electronics (OEs) and Photonics, Thin films, Nanomaterials and Nanoengineering Technologies, Nanomedicine, 3D Printing and 3D Bioprinting, Nanometrology, In-line precision Metrology, Quality Control of Processes, Automation, Additive and Digital Manufacturing.

LTFN in 2014, established, the COPE-H (Center of Organic & Printed Electronics - Hellas) in Thermi, 2km from Thessaloniki airport, for cutting-edge Research and Manufacturing of OE devices for applications in Energy, Lighting, Electronics, Buildings, Automotive, Nanobiomedicine, Wearables, IoT, IoP, Smart Packaging, Greenhouses, etc.

LTFN has an experience of more than 30 years in Thin films Technology, fabrication of advanced nanomaterials and nanoparticles, developing in-situ and real-time optical metrology techniques, computational modeling and nanometrology tools. LTFN has strong interaction and links with Academia, Research Institutes, SMEs and Industry. Equipped with 10 Pilot Lines and several TestBed facilities, LTFN is a Digital Innovation Hub. It acts as a One-Stop-Shop offering Open Access facilities to interested entities (Academia, Research, Start-Ups, SMEs, Industries) and provides companies with Technology testing and Expertise, Incubation, Ecosystem building, Skills development and Access to Funding services. Moreover, it creates highly specialized and educated graduates, researchers and entrepreneurs for the society.

LTFN coordinates many EU/National R&D Projects, has founded the Hellenic Organic & Printed Electronics Association HOPE-A, the R&I Network Nano|Net, the Post Graduate Program on Nanosciences & Nanotechnologies - NN, and organizes annually the internationally established NANOTEXNOLOGY multi-event which comprises International Conferences, Summer Schools and Exhibitions on Nanotechnology, Organic Electronics, 3D Printing, 3D Bioprinting & Digital Manufacturing and Nanomedicine.

"The mission of LTFN is to promote world-class research and best-practices in Nanotechnology, Organic Electronics & Photonics, Thin Films & Advanced Materials, Nanomedicine & 3D Bioprinting, Additive Manufacturing and Nanometrology in order to address global challenges in Manufacturing, Energy, Lighting, Electronics, Photonics, IoT, IoP, Buildings, Transportation, Health and Quality of Life, Agriculture, etc."
LTFN in numbers

- **35** Researchers
- **7** Technicians & Support
- **2000 m²** of Lab space
- **>100** affiliated labs and clusters
- **>100** completed research projects
- **8** active research projects
- **26** Books & Chapters
- **>300** high impact publications
- **5** Patents
- **3** Spin-out companies
- **>30** Workshops and Conferences organized

Research Fields

- Organic Electronics & Photonics Technology
- Thin Films & Nanobiomaterials Technology
- Nanoengineering & Surface Engineering
- Nanomedicine & Nanobiotechnology
- Optical Technology, Precision Nanometry, Quality Control & Automation
- Digital & Additive Nanomanufacturing
- 3D Printing & 3D Bioprinting
- Computational & Modeling at the Nanoscale to Mesoscale

main Objectives

**Research**

LTFN is a world-class excellence entity in various research fields, with state-of-the-art equipment and facilities, 10 Pilot Lines and TestBeds, combined with strong activity in R&D projects and dynamic collaborations with SMEs, industry and academia.

**Applications**

Through its excellent research activities and innovation, LTFN covers various applications in Energy, Lighting, Electronics, Buildings, Automotive, Agriculture, IoT, Smart Packaging, Nanobiomedicine, Wearables, IoT, Information and Communication Technology etc.

**Collaborations**

LTFN has developed strong collaborations with numerous education and research institutes in Europe, USA and Asia, while continues networking and partnership with key players from academia and industry worldwide.

**Training activities**

LTFN creates highly skilled scientists with strong track-record and capacities by teaching and training students, young researchers and new scientists of 2 Post Graduate Programs, using its world-class infrastructure and know-how. It also offers Masterclasses to Companies to update their business in its areas of Expertise.
Organic & Printed Electronics

LTFN is equipped with 3 worldwide unique pilot lines and clean room facilities and develops cutting-edge technologies for the Digital Nanomanufacturing of OE devices and multiscale characterization.

**R2R Pilot & Production line**

Large area R2R manufacturing of OPVs, OLEDs, Sensors, OFETs onto plastics, equipped with Ultra-fast Laser scribing and in-line metrology systems.

The main technologies used are: Printing (Slot-Die, Inkjet & Screen printing) | Ultra-fast Laser Patterning | Encapsulation module | Raman spectroscopy & In-line Spectroscopic Ellipsometry

**Sheet2Sheet Pilot line**

Hybrid printing and vacuum technologies for OE devices with encapsulation technologies and solar simulator system.

**OVPD Cluster - Gas Transport Pilot line**

Scalable OVPD Pilot Line equipped with in-situ optical metrology systems (Raman Spectroscopy, Spectroscopic Ellipsometry) for high precision fabrication of OPVs, OLEDs and sensors.
Lab Scale Printing

LTFN excellence covers a wide spectrum of **printing techniques** (S2S Gravure, Slot-Die, Inkjet, etc.) for the Digital fabrication of Organic Electronics and Bioelectronics nanomaterials, devices and systems.

Ex-situ Laser System

High energy laser systems for ultra fast processes (laser ablation, laser annealing, patterning etc.) for fabrication and functionalization of novel nanomaterials and nanoparticles.

Thin Films, Nanomaterials & Nanoengineering

CVD Pilot line

By the **Thermal and Plasma CVD Pilot line**, LTFN pioneers in Graphene and 2D nanomaterials growth in 6” wafers for cutting edge research and applications in nanoelectronics and photonics. The system is equipped with **real-time optical monitoring techniques such as Vis-UV SE and Raman** for in-situ characterization and process optimization.

2 Ultra High & 1 High Vacuum Pilot lines

High Vacuum and Ultra HV pilot lines equipped with state-of-the-art PVD techniques (Magnetron Sputtering, HiPIMS, Thermal, Electron-gun Evaporation) for thin film growth on 2D/3D substrates. LTFN focuses on the growth of multifunctional (protective, superhard and tribo-coatings, optical, plasmonic, decorative and biocompatible) for a wide range of applications (cutting-tools, ophthalmic lenses, optoelectronics, energy harvesting and medical implants). It also has strong experience on Real-time optical and plasma monitoring for growth process control.

Surface & Nanomechanical characterization facilities

LTFN possesses a variety of systems (SPM platforms, SNOM and Nanoindentation systems) that enable the surface and nanomechanical characterization of nanomaterials and devices.
Nanomedicine & Nanobiotechnology

LTFN makes use of cutting-edge equipment and 2 Pilot Lines for nanomaterials synthesis, characterization and in vitro studies. Facilities include cell culture, coating and 3D electrospraying deposition and printing systems, while a fully equipped chemical laboratory is available for nanoparticles, nanofibers and nanofilms development and biofunctionalization.

This research field, includes the design, development, validation and production of drug delivery nanosystems and biomedical devices, smart nanomaterials, nanoporous delivery platforms, scaffolds for tissue regeneration, nanoparticles for in vivo diagnostics, treatment of diseases etc.

Products & Applications

- Biodegradable nanoparticles with Anti-oxidant drugs for reduction of Oxidative Stress
- Biodegradable scaffolds for Drug Delivery and Tissue Engineering (CVDs, Osteoarthitis, Wound healing, etc.)
- Nanoporous materials loaded with Drugs, 3D Printing and 3D BioPrinting
- Biodegradable nanosystems deposited onto implants (Stents and Orthopedics)
- Nanoparticles onto surfaces to enhance antimicrobial and antibacterial behavior
The recently established 3D-BioPrinting Laboratory is located at the facilities of the LTFN Nanomedicine & Nanobiotechnology Group. It is run by multidisciplinary research members, who have at their disposal state-of-the-art 3D-Bioprinting, 3D-Printing and other 3D-scaffold manufacturing technologies for the production of complex structures as well as characterization tools for the static and dynamic in vitro testing of the cell seeded structures.

The facility focuses initially in orthopaedics aiming to the regeneration of patient specific osteochondral defects, cartilage, ligaments and joints. Working in close collaboration with other groups of the LTFN we exploit established know-how on:

- Design, development, validation and production of nano-biomaterials as scaffolds
- Biodegradable nanoparticles as drug carriers for their selective spatial distribution within the 3D-Bioprinted structures
- Biodegradable nanofibers for the enhancement of vascularization
- Organic and printed electronics for the innovative introduction of sensing/biosensing elements and intervening methods in selected areas of the 3D-Bioprinted structures
- Drug delivery systems loaded with growth factors for the spatial biofunctionalization as required
Optical Technology & Nanometrology TestBeds

**LTFN** is a world-class pioneer in Optical Technology and Nanometrology that develops in-situ, in-line and ex-situ Optical Metrology techniques and methodologies for nanomaterials, systems characterization and process optimization.

Its state-of-the-art Nanometrology facilities include:
- Spectroscopic Ellipsometry (IR-NIR-Vis-farUV, ex-situ, in-situ, in-line)
- Raman & Photoluminescence
- Solar Simulators (from lab to large scale)
- X-rays Measurements (XRR, XRD, XDS)
- Scanning near-field microscopy (SNOM)
- Electrical Characterization
- SPM & Nanomechanical Characterization Platforms
- Luminescence & Photoluminescence
- Water Vapour Transmission measurements
- Contact angle measurements
- XPS, AES, TEM, SEM (access)

Computational & Modeling at the Nanoscale to Mesoscale

**LTFN** has a strong expertise in multiscale Computational Modeling from nano- to macro- with the target to understand the growth mechanisms and properties of novel materials, materials’ behavior and/or nano-device manufacturing processes with the target to enable the reliable large-scale manufacturing of devices and systems.

The Computational modeling capabilities of **LTFN** include:
- Bottom-up modeling approach using First principles calculations (DFT)
- Modeling and analysis methods of structural, optical and vibrational properties of isotropic/anisotropic nanomaterials, 2D materials, nanoparticles, polymers, inorganic/organic hybrid systems
- Optoelectronic modeling of OE devices (OPVs, OLEDs, OTFTs, etc.)
- Optical Engineering for OE devices and Optical Systems
- Modeling of nanomechanical response of multilayered structures
LTFN Research and Innovation Success stories

Reinforce Organic Electronics Research Potential in K. Makedonia

FP7-REGPOT (2011-2014)

Consortium: 12 Partners from 4 EU Countries

Total Budget: 2.740.000 €

ROleMak’s main scopes

• Strong reinforcement of R&D excellence of AUTH in OEs
• Recruitment of first class scientists in OEs at AUTH
• Upgrade of AUTH’s research infrastructure with new lab facilities and novel equipment for OE devices
• Contribution to the establishment of the COPE-H
• Dissemination and exploitation of the results in OEs
• Build of strong strategic partnerships and collaborations with EU research and academic groups
• Establishment of HOPE-A

ROleMak’s success story in numbers:

• 70 Incoming/Outgoing visits
• 10 exceptional scientists recruited by AUTH
• 35 new researchers, 15 researchers & 10 senior researchers trained
• 8 publications in international scientific journals
• 45 presentations in 20 international scientific conferences
• 3 International conferences organization
• 11 International Workshops organization
• 4 new companies
• >20 new collaborations
• 8 new R&I Projects

www.rolemak.eu
Graphene Layers: Production, Characterization & Integration

FP7 NMP Project (2013-2017) / LTFN participation

Consortium: 15 Partners from 7 EU Countries

Total Budget: 12,398,941 €

LTFN innovations in Gladiator

- Development and installation of in-situ Optical Metrology tools (SE, RS) on AUTH’s unique CVD System
- Development of optical models and methodologies for the in-situ and real-time investigation of growth mechanisms of graphene on metallic substrates (Cu, Ni)
- Contribution on the optimization of graphene growth process by Chemical Vapor Deposition

NSRF (2013-2015)

Consortium: 6 Partners from Greece

GR-Light’s main scopes

Development of the R2R Manufacturing Technology and the flexible OLED devices for the production of Sustainable and eco-friendly Lighting systems

Green/Greek Sustainable Lighting

www.gr-light.gr

www.graphene-gladiator.eu
Development of Smart Machines, Tools & Processes for Nanomaterials with Tailored properties for Organic Electronics

FP7 IP NMP Project (2013-2016)

Consortium: 18 Partners from 6 EU Countries (7 Uni, 3 Inst, 8 Industries)

Total Budget: 11,593,843 €

Awarded by EU as Best Project (1st Runner Up) in ENF2017

Smartonics’s objectives & major achievements

- **Smart Nanomaterials for OEs** by process and computational modeling optimization
- **Smart Technologies** R2R printing and OVPD machines combined with precision sensing (SE, RS, PL), Laser tools and Inkjet Printing
- **Unique Pilot Lines** for precision synthesis of OE devices (OPVs, OLEDs, OTFTs) and evaluation for industrial applications (automotive)

**OPV Efficiency Records**

- S2S OPV Cell=8.0%
- S2S OPV Module=5%
- R2R OPV Cell=5.4%
- R2R OPV Module=3.5%
- OVPD OPV Cell=4.0%
- OPV Lifetime>8yrs (WVTR:<1·10^{-5} g/(m²d))
- OPV Roof power:12W, Voltage:18V

**Dissemination/Exploitation**

- Papers=35
- Press Releases=9
- School Lectures=27
- Participations in Exhibitions=68
- Conference Presentations=193
- Conference Organization=15
- Patents>5

Awarded with EU Best Project Award (1st runner-up) during EuroNanoForum 2017
## LTFN excellence in Research, Technology and Innovation - Timeline

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<th>ISOTECH</th>
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<td><strong>BRITE EURAM</strong></td>
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<td><strong>EU FP7</strong></td>
<td><strong>EU FP7</strong></td>
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</tr>
<tr>
<td>In-situ Optical Monitoring techniques for tailoring thin film properties for advanced industrial applications</td>
<td>Transparent films, vacuum coatings machine with integrated in-line monitoring and control</td>
<td>Ultra-high barrier films for R2R encapsulation of flexible electronics devices</td>
<td>Processes and technologies for flexible OEs production</td>
<td>Network of excellence for building up knowledge for improved systems integration for flexible organic and large area electronics and its exploitation</td>
<td>Integration of flexible OPVs onto textile products</td>
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### Rated as OUTSTANDING

#### ISOTECH
- **BRITE EURAM** 1997-2000
- **EU FP5** 2000-2005
- **EU FP6** 2005-2008
- **EU FP7** 2008-2011
- **EU FP7** 2010-2012
- **NSRF 2007-2013** 2013-2015

#### TRANSMACH
- **EU FP5** 2000-2005
- **EU FP6** 2005-2008
- **EU FP7** 2008-2011
- **EU FP7** 2010-2012
- **EU FP7** 2013-2015

#### FLEXONICS
- **EU FP6** 2005-2008
- **EU FP7** 2008-2011
- **EU FP7** 2013-2017

#### OLATRONICS
- **EU FP6** 2005-2008
- **EU FP7** 2008-2011
- **EU FP7** 2013-2017

#### FLEXNET
- **EU FP7** 2010-2012
- **NSRF 2007-2013** 2013-2015

#### YFATRONIC
- **NSRF 2007-2013** 2013-2015

### Collaborations
- **17 Partners from 11 EU countries**
- **4 Greek companies**
- **15 Partners from 7 EU countries**
- **18 Partners from 7 EU countries**

### Projects
- **Best EU Project Award**
- **2 unique Pilot Lines (R2R, OVPD) in LTFN**

### Technologies
- **Multifunctional Nanocoatings**
- **Plasmonic architectures**
- **R2R manufacturing technology & flexible OLEDs**
- **Production, characterization and integration of graphene layers**
- **Incorporation of Plasmonic nanocomposites in OPVs**

### Applications
- **Network of excellence for building up knowledge for improved systems integration for flexible organic and large area electronics and its exploitation**
- **Integration of flexible OPVs onto textile products**

### Images
- **FlexNet**
- **Nanohybrid**
- **Plasmon-Harvest**
- **GR-Light**
- **Gladiator**
- **Smartonics**
### LTFN excellence in Research, Technology and Innovation - Timeline

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<tr>
<td>Development of nanostructured organic and inorganic materials and thin films for the production of OEs devices</td>
<td>Production of implants from biomaterials that regenerate tissue/Manufacturing of bioinspired materials for Cardiovascular implants</td>
<td>Promotion of the commercial exploitation of OLAЕ technology for the benefit of European Industry and business and the welfare of European countries</td>
<td>Reinforce Organic Electronics research potential in Central Makedonia</td>
<td>Development of Graphene-based advanced hybrid electrodes to improve the performance of Organic electronic devices</td>
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<tr>
<td><strong>2 Greek companies</strong></td>
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<tr>
<th>BASMATI</th>
<th>NANOREG2</th>
<th>SMARTLINE</th>
<th>CORNET</th>
<th>APOLLON &amp; PHOTOKIPIA</th>
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<tr>
<td>Bringing innovation by scaling up nanomaterials and inks for printing</td>
<td>Regulations for safe-by-design approaches</td>
<td>Intelligent manufacturing processes for OE devices with metrology tools and process control platform</td>
<td>Multiscale modeling and characterization to optimize manufacturing processes of OE materials and devices</td>
<td>APOLLON: Printed OLEDs for intelligent, efficient &amp; tunable solid-state lighting devices in Large Scale</td>
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<tr>
<td>Pilot lines for low cost inks dedicated to printed electronics</td>
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<td>PHOTOKIPIA: Semitransparent Organic and Printed Photovoltaics for Energy Efficient Mediterranean Greenhouses</td>
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LTFN recent Research and Innovation Activities

**Smart In-line metrology and control for boosting the yield and quality of high-volume Manufacturing of Organic Electronics**

**H2020-FOF-08-2017 Project (2017-2020)**

**Consortium:** 7 Partners from 4 EU Countries (Greece, Italy, Germany, The Netherlands)

**Total Budget:** 4.200.000 €

**Smartline** will create the **Factory of the Future** in Organic Electronics (OLAE) by developing intelligent zero-defect closed-loop manufacturing processes (R2R printing, OVPD) for OLAE devices (OPVs, OLEDs).

**Main objectives**

- Develop a robust, non-destructive and in-line optical and electrical metrology tools and methodologies (SE, RS, PL, EC, WSI, Reflectometry)
- Integrate in-line metrology tools in unique R2R printing and OVPD pilot to production lines
- Develop a unique feedback Platform from the in-line metrology tools to control the processes through non-destructive and traceable in-line measurements and algorithms, combined with contribution to standardization and reference materials
- Optimize the R2R printing and OVPD manufacturing processes reliability in pilot production lines
- Fabricate homogeneous OPV and OLEDs and demonstration to industrial applications (e.g. automotive)
**LTFN recent Research and Innovation Activities**

**Multiscale Modeling and Characterization to optimize the manufacturing processes of Organic Electronics materials & devices**


**Consortium:** 11 Partners from 6 EU Countries (Greece, UK, Italy, France, Switzerland, Germany)

**Total Budget:** 3.900.000 €

**Cornet** will develop a unique EU Open Innovation Environment (OIE) covering the triangle of manufacturing, modeling and experimentation. The project will strongly impact the fast and reliable development of new materials, devices and will enable control of the related production processes to fabricate tailored OE devices and systems for industrial applications.

**Main objectives**
- Develop an effective OIE connecting world-class industrial, academic and research experts in manufacturing, multiscale characterization and modeling, for optimization of OE materials, processes and for a reliable database, citable protocols and contribution to standards
- Multiscale characterization and modeling to optimize OE materials and devices fabrication and validation of materials models for faster development cycle and time-to-market
- Optimize the fabrication of OPV, PPV and OLED devices by R2R printing and OVPD manufacturing processes
- Efficient large scale fabrication of tailored nano-devices by R2R printing and OVPD processes and demonstration to industrial applications
LTFN recent Research and Innovation Activities

APOLLON: Printed OLEDs for intelligent, efficient & tunable solid-state lighting devices in Large Scale

Consortium: 5 Partners (2 Academic & 3 SMEs)
Total Budget: 906,000 €

The core idea of APOLLON is to deploy the Value Chain in order to implement a sustainable and environmentally friendly OLED large scale production process using R2R and S2S techniques, while appropriate processes and techniques with high barrier materials will be applied to encapsulate, protect and increase their lifetime.

Main objectives
• Developing flexible and rigid OLEDs with cost-effective R2R and S2S printing processes
• Develop an efficient manufacturing technology
• Integrate OLED into innovative operating systems
• Production of autonomous lighting systems for interior lighting, safety signs and smart protective clothing
• Development of innovative lighting products

PHOTOKIPIA: Semitransparent Organic and Printed Photovoltaics for Energy Efficient Mediterranean Greenhouses

Consortium: 4 Partners (2 Academic & 2 SMEs)
Total Budget: 853,000 €

PHOTOKIPIA aims to develop an “Energy Efficient Greenhouse” based on large area OPVs, using R2R printing techniques, combined with in-line nano-layer scribing techniques with ultra-fast pulse laser and optical metrology for their final application to Mediterranean (MG) type Greenhouses.

Main objectives
• Development and Optimization of R2R Printed Transparent Electrodes
• Optimization of R2R Printing Processes for manufacturing large scale S-OPVs and Optical Engineering of nanolayers
• Development of wireless monitoring system of MG and recording parameters of S-OPV panels
• Integration of H-OPV panels to MG and evaluation of their performance and impact on cultivation
LTFN external activities & Organizations

Hellenic Organic & Printed Electronics Association HOPE-A

LTFN founded the Hellenic Organic and Printed Electronics Association HOPE-A. HOPE-A’s main scope is to organize and co-ordinate the activities of Industrial and Research organizations in Greece, in the field of Organic and Printed Electronics, while strengthening their goals.

HOPE-A scopes include:

• Coordination of the network of companies in OEs applications
• Development of strong links between R&D&I, Technology and Business
• Generation of new technologies, applications, roadmaps and reports
• Enhancement of the reputation of the Sector
• Members support to new markers and trade-shows
• Members’ Representation to International Authorities
• Distribution of information from the markets
• Investements attraction in OEs
• Collaboration with OEs global Organizations and Companies
• Exhibitions, Workshops, Seminars and training activities organization

www.hope-a.com
Counting more than 30 members from greek Industry and bringing together more than 1000 entities in OEs worldwide

International Collaborations

Materials
Chemicals

Design

Process
Equipment

Products
End Users

OPVs
OLEDs
OTFTs
Sensors
Biosensors

RFIDs
Batteries
Diagnostics
Hybrid Systems

Smart Textiles, Smart Packaging Wearables, IoT, Energy, Lighting Energy Autonomous Systems Automotive, Buildings Integrated Smart Systems
**Research & Innovation Network Nano|Net**

Nano|Net is an initiative for the promotion and collaboration between research and business organizations active in the fields of Nano-Bio-Technologies. Nano|Net established on 2003 by Nanotechnology Lab LTFN and at the moment counts more than 600 members (Universities, Research Centers, SMEs, Industries, Hospitals) Worldwide.

Nano|Net contains 7 Thematic Clusters:

**Vertical Clusters**
- Thin Films & Organic Electronics
- Nanomaterials & Nanoengineering
- Nano(Bio)Medicine
- Nano in Energy & Environment

**Horizontal Clusters**
- Nanometrology & Tools
- Modeling at the Nanoscale
- Legal, Ethics & Health Safety Issues

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**Greek Nanomedicine Platform GR-Nanomed**

The Greek Nanomedicine Platform GR-Nanomed has been established to promote Nanomedicine Research and its translation into Clinical Practice in Greece, under the umbrella of Nano|Net. To date more than 130 Nanomedicine companies, Research Organizations and Hospitals are members of the platform.

www.nano-net.gr/gr-nanomed
LTFN external activities & Organizations

**NANOTEXNOLOGY International Conferences & Exhibition**

LTFN organizes since 2004, the **NANOTEXNOLOGY** which is one of the largest technology, networking and matchmaking annual event in Europe, that gathers more than 1000 participants from 60 countries every year. It includes the following well established events:

- **International Conference on Nanosciences & Nanotechnologies (NN)**
- **International Symposium on Flexible Organic Electronics (ISFOE)**
- **International Conference on 3D Printing, 3D Bioprinting, Digital & Additive Manufacturing (I3D)**
- **International Summer Schools Nanosciences and Nanotechnologies, Organic Electronics & Nanomedicine (ISSON)**
- **International Exhibition on Nanotechnologies, Organic Electronics & Nanomedicine (NANO-EXPO)**
- **Business Forum**
- **Matchmaking Event**

**International Symposium on Flexible Organic Electronics - ISFOE**

ISFOE is the biggest scientific and technology event in Flexible Organic & Printed Electronics, that promotes the research, technology and innovation in OE nanomaterials, manufacturing processes, devices, applications and solutions. During ISFOE you will meet with other world-class scientists, engineers, people from industry and policy makers to discuss and exchange ideas on the hottest topics and progress on OEs.

**International Conference on 3D Printing, 3D Bioprinting, Digital & Additive Manufacturing - I3D**

I3D focuses on the cutting edge advances on 3D Printing, 3D Bioprinting, Digital and Additive Manufacturing approaches for Flexible Organic and Printed Electronics, Healthcare, Wearables, Automotive, etc. and for the fabrication of novel nanomaterials in advanced device architectures.

**International Conference on Nanosciences & Nanotechnologies - NN**

NN is the internationally established world-class event in Nanosciences and Nanotechnologies that focuses on the latest advances on N&N and promotes profound scientific discussions between scientists and researchers from different disciplines. Front-line experts from multidisciplinary research and application areas are encouraged to join this conference, to discuss the benefits of N&N in their R&D efforts, to advance the networking and collaborating between different academia, research and industry players in the field and to stimulate the exchange of educational concepts.
LTFN external activities & Organizations

**International Summer Schools on NN, OEs & Nanomedicine - ISSON**

The ISSON Summer Schools gives the opportunity to young researchers and early-career scientists and engineers to participate in a series of lectures on the emerging fields of Nanosciences & Nanotechnologies, Organic Electronics and Nanomedicine.

**International Exhibition on Nanotechnologies, OEs & Nanomedicine**

The NANO-EXPO unites innovators to bring Nanotechnology, Organic Electronics & Nanomedicine from Lab to market, while is the biggest marketplace for the related fields, products, applications and research in Europe. The fully integrated exhibition enables you to demonstrate and discover state-of-the-art prototypes, technologies and research results from innovative companies, leading research institutes, high-tech clusters, SMEs and EU-projects.

**Business Forum**

NANOTEXNOLOGY Business Forum forms a powerful and high-end platform to foster your maximum exposure and enables business development opportunities for innovative start-up, spin-off, spin-out companies and SMEs.

**Matchmaking Event**

The Matchmaking Event encourages meetings between technology developers and technology users in order to foster technical cooperation in the fields of Nanotechnologies & Organic Electronics. It provides an opportunity for transnational technology, business and research partnerships.

www.nanotexnology.com
Nanotechnology Lab LTFN as a Digital Innovation Hub

The Nanotechnology Lab LTFN is a Digital Innovation Hub acting as a One-Stop-Shop offering a plethora of innovative services to companies to support them fully benefit from digital innovations and update their business, production processes, products and services. Nanotechnology Lab LTFN provides companies with Access to State-of-the-art Technologies, Facilities, Networking, Funding Opportunities and Skills Development Services so that they successfully adapt to the Industry 4.0 era.

Services provided:
• TestBeds
• Expertise
• Networking & Ecosystem Building
• Education & Skills development
• Access to funding

TestBeds & Competences
Nanotechnology Lab LTFN equipped with 10 Pilot to Production Lines and several Testbeds in Organic & Printed Electronics & Photonics, Thin Films, Nanomaterials & Nanoengineering, Nanomedicine & Nanobiotechnology, Optical Technology & Nanometrology offers to Companies and Research entities access to its facilities and, therefore, Experimentation and Technology testing, Proof-of-Concept and Scaling-up services.

Expertise
Nanotechnology Lab LTFN offers Know-How to its areas of specialist Expertise by access to infrastructure and training sessions.

Access to Funding
Having yearlong experience in National and European funding mechanisms, the Nanotechnology Lab LTFN provides advice to research and business entities on appropriate financing tools and opportunities that can be utilized to finance their activities.
Nanotechnology Lab LTFN as a Digital Innovation Hub

Networking & Ecosystem Building

Nanotechnology Lab LTFN has built a vibrant business-technology ecosystem providing partnership opportunities to companies to widen their networks and form business collaborations.

**HOPE-A**, with a worldwide network of more than 1000 companies occupied in OEs, organizes Joint Workshops with its international partners, Exhibitions and B2B Meetings bringing business and research actors close to create joint ventures. **Nano|Net**, a Worldwide Network of more than 600 individual members (~1200 cluster members), organizes Workshops and provides Brokerage services for international collaborations. **GR NanoMed Platform**, with 130 Nanomedicine Companies, Institutions & Hospitals from around the globe, organizes Workshops promoting international collaborations. **NANOTEXNOLOGY**, the international multi-event in Nanotechnologies, Organic Electronics and Nanomedicine, brings annually together over 1,000 stakeholders through International Conferences, Summer Schools, Exhibition, Business Forum and Matchmaking Events.

Education & Skills Development

Given that the emphasis of the digital era is on the Training and Skills development of the workforce, the Nanotechnology Lab LTFN runs Masterclasses for Companies on its cutting-edge areas of Expertise, comprising Lectures, Demos of state-of-the-art techniques & Visits to lab facilities.

LTFN runs the Postgraduate Program on Nanotechnologies which provides advanced training to the next generation of researchers & entrepreneurs, and organizes International Summer Schools giving the opportunity to early-career scientists & engineers to grasp the current trends in Nanosciences & Nanotechnologies, OEs, 3D Printing, 3D Bioprinting, Digital & Additive Manufacturing and Nanomedicine.
How you will find us?

1. Nanotechnology Lab LTFN
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   54124 Thessaloniki

2. COPE-H facilities
   Thessaloniki airport area, 15km
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