ARISTOTLE
UNIVERSITY OF
THESSALONIKI

ltfn
Nanotechnology Lab

Nanotechnology Lab LTFN

Lab for Thin Films - Nanobiomaterials Nanosystems & Nanometrology

www.ltfn.gr

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.

Stergios Logothetidis, *Founder & Director of Nanotechnology Lab LTFN*

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
- Thin Films & Nanobiomaterials Technology
- Nanoengineering & Surface Engineering
- Nanomedicine & Nanobiotechnology
- Optical Technology, Precision Nanometrology, 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, IoP, Smart Packaging, Nanobiomedicine, Wearables, IoT, Information and Communication Technology etc.

Collaborations

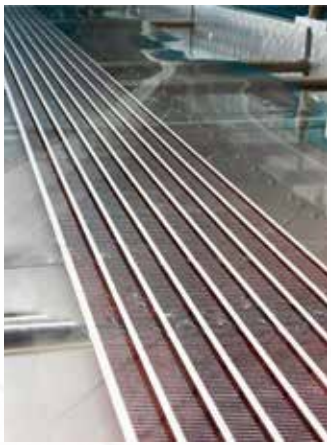
LTFN has developed strong collaborations with numerous education and research institutes in Europe, USA and Asia, while continues networking and partnership with key players from academia and industry worldwide.

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

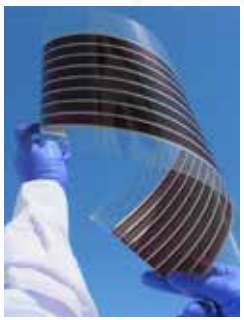
LTFN is equipped with **3 worldwide unique pilot lines and clean room facilities** and develops cutting-edge technologies for the Digital Nanomanufacturing of OE devices and multiscale characterization.



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.

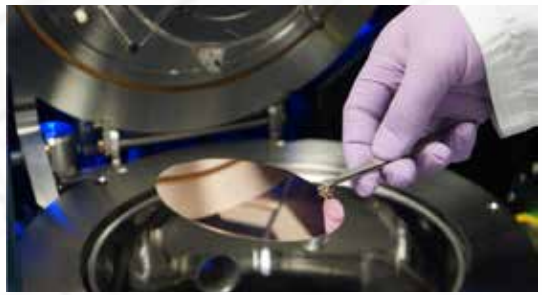
Ex-situ Laser System

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 T**hermal 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.

Synthesis of Engineered Nanoparticles

LTFN has a fully equipped laboratory for chemical synthesis, laser-based fabrication and solution processing of a broad range of inorganic and organic nanoparticles for various applications in Organic Electronics and Nanomedicine.

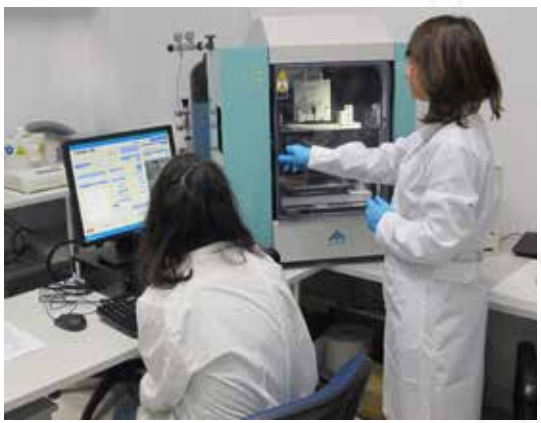
Nanomedicine & Nanobiotechnology

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, Osteoathritis, 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

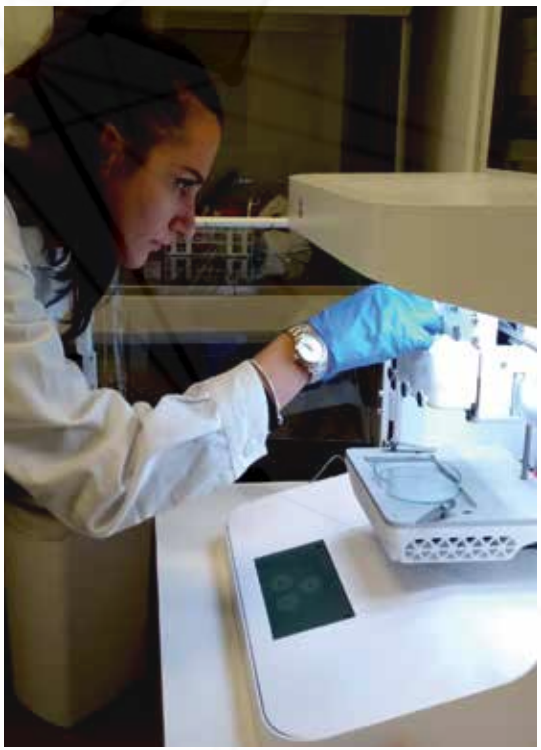


Nanomedicine & Nanobiotechnology - 3D Bioprinting

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-bio-materials 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

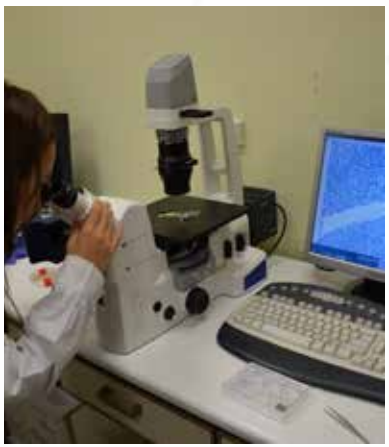


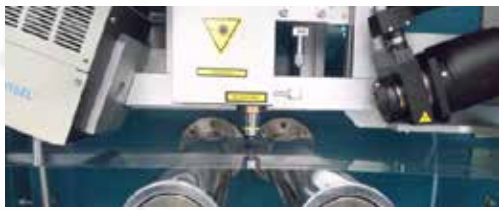
Optical Technology & Nanometrology TestBeds

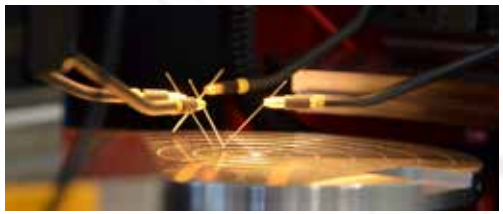
LTFN is a world-class pioneer in Optical Technology and Nanometrology that develops in-situ, in-line and ex-situ Optical Metrology techniques and methodologies for nanomaterials, systems characterization and process optimization.

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)





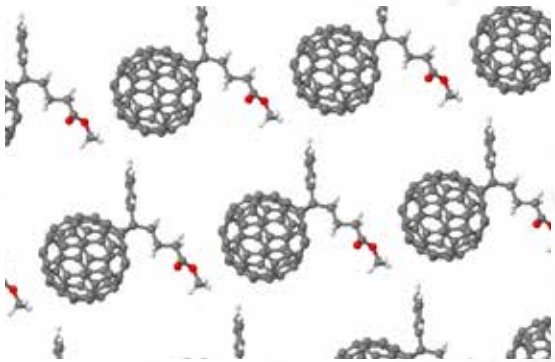


Computational & Modeling at the Nanoscale to Mesoscale

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

ROleMak

www.rolemak.eu

LTFN Research and Innovation Success stories

Green/Greek Sustainable Lighting

NSRF (2013-2015)

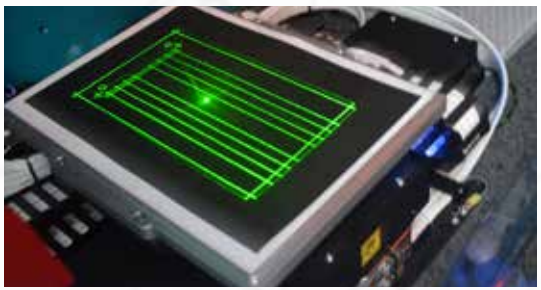
Consortium: 6 Partners from Greece

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

GR-Light

www.gr-light.gr



Graphene Layers: Production, Characterization & Integration

FP7 NMP Project (2013-2017) / LTFN participation

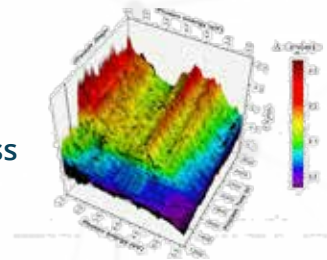
Consortium: 15 Partners from 7 EU Countries

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

graphene-gladiator.eu



LTFN Research and Innovation Success stories

Development of Smart Machines, Tools & Processes for Nanomaterials with Tailored properties for Organic Electronics

www.smartonics.eu

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

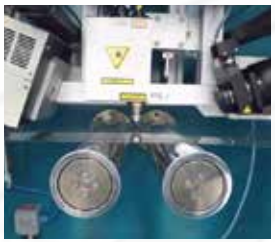
- **Smart Nanomaterials for OEs** by process and computational modeling optimization
- **Smart Technologies** R2R printing and OVPD machines combined with precision sensing (SE, RS, PL), Laser tools and Inkjet Printing
- **Unique Pilot Lines** for precision synthesis of OE devices (OPVs, OLEDs, OTFTs)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

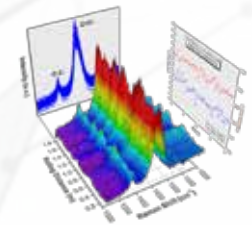
OPV Efficiency Records

- 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:<$1 \cdot 10^{-5}$ g/(m^2d))
- 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

ISOTECH

1997-2000
BRITE EURAM

In-situ Optical Monitoring techniques for tailoring thin film properties for advanced industrial applications

Rated as OUTSTANDING

TRANSMACH

2000-2005
EU FP5

Transparent films, vacuum coatings machine with integrated in-line monitoring and control

Rated as OUTSTANDING

FLEXONICS

2005-2008
EU FP6

Ultra-high barrier films for R2R encapsulation of flexible electronics devices

Rated as FP6 success story

OLATRONICS

2008-2011
EU FP7

Processes and technologies for flexible OEs production

FLEXNET

2010-2012
EU FP7

Network of excellence for building up knowledge for improved systems integration for flexible organic and large area electronics and its exploitation

17 Partners from 11 EU countries

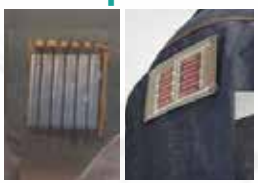
FlexNet

YFATRONIC

2010-2013
NSRF 2007-2013

Integration of flexible OPVs onto textile products

4 Greek companies



NANOHYBRID

2013-2015
NSRF 2007-2013

Multifunctional Nanocoatings with hybrid organic-inorganic interfaces

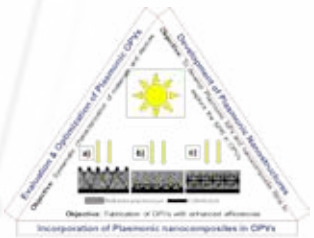
Applications on 3D (razor blades) and 2D (polymeric lenses) substrates

PLASMON-HARVEST

2013-2015
NSRF 2007-2013

Plasmonic architectures for solar energy harvesting

Enhancing of the solar energy harvesting of OPV devices using noble metals nanoparticles with LSPR

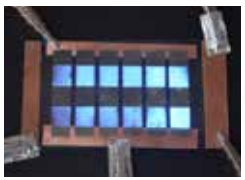


GR-LIGHT

2013-2015
NSRF 2007-2013

R2R manufacturing technology & flexible OLEDs for production of sustainable & eco-friendly lighting systems

Collaboration with 4 Greek companies

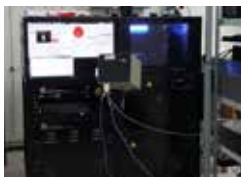


GLADIATOR

2013-2017
EU FP7

Production, characterization and integration of graphene layers

15 Partners from 7 EU countries



SMARTONICS

2013-2016
EU FP7

Development of smart machines, tools and processes for the precision synthesis of nanomaterials with tailored properties for OEs | 2 unique Pilot Lines (R2R, OVPD) in LTFN

18 Partners from 7 EU countries

Best EU Project Award

LTFN excellence in Research, Technology and Innovation - Timeline

NANORGANIC

2010-2013
NSRF 2007-2013

Development of nanostructured organic and inorganic materials and thin films for the production of OEs devices

2 Greek companies

NANOARTHROCHONDROS NANOCARDIO

2011-2014
NSRF 2007-2013

Production of implants from biomaterials that regenerate tissue/ Manufacturing of bioinspired materials for Cardiovascular implants

COLAE

2011-2014
EU FP7

Promotion of the commercial exploitation of OLAE technology for the benefit of European Industry and business and the welfare of European countries

17 Partners from 13 EU countries

COLAE
Commercialising Organic and Large Area Electronics

ROLEMAK

2011-2014
EU FP7

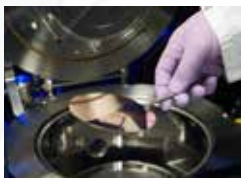
Reinforce Organic Electronics research potential in Central Makedonia

12 Partners from 4 EU countries

GRELECT

2013-2015
NSRF 2007-2013

Development of Graphene-based advanced hybrid electrodes to improve the performance of Organic electronic devices



BASMATI

2015-2017
EU H2020

Bringing innovation by scaling up nanomaterials and inks for printing

Pilot lines for low cost inks dedicated to printed electronics

NANOREG2

2015-2018
EU H2020

Regulations for safe-by-design approaches

SMARTLINE

2017-2020
EU H2020

Intelligent manufacturing processes for OE devices with metrology tools and process control platform

Factories of the Future

Smart line

CORNET

2018-2021
EU H2020

Multiscale modeling and characterization to optimize manufacturing processes of OE materials and devices

Open Innovation

APOLLON & PHOTOKIPIA

2018-2021
NSRF 2014-2020

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

Apollon

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

photokipia

LTFN excellence in Research, Technology and Innovation - Timeline

NanoAthero

2020-2022
NSRF 2014-2020
T2ΕΔΚ-00563

Development and Preclinical Validation of biofunctionalized Nanoparticles for targeted delivery of anti-oxidant factors to treat Atherosclerosis

3 Partners (1 academic & 2 SMEs)

RealNano

2020-2023
EU H2020

In-line and Real-time Nano-characterization technologies for the high yield manufacturing of Flexible Organic Electronics

10 Partners from 6 EU countries

FlexFunction2Sustain

2020-2024
EU H2020

Open Innovation Ecosystem for Sustainable Nano-functionalized Flexible Plastic and Paper Surfaces and Membranes

19 Partners from all over Europe

MUSICODE

2021-2024
EU H2020

An experimentally-validated multi-scale materials, process and device modeling & design platform enabling non-expert access to open innovation in the organic and large area electronics industry

11 Partners from 6 EU countries

nanoMECommons

2021-2025
EU H2020

Harmonisation of EU-wide nanomechanics protocols and relevant data exchange procedures, across representative cases; standardisation, interoperability, data workflow

19 Partners from 10 EU countries

Flex2Energy

2023-2026
HORIZON EUROPE
HORIZON Innovation Actions

Automated Manufacturing Production Line for Integrated Printed Organic Photovoltaics

15 Partners from 7 EU countries

This project has received funding from the European Union's Horizon Europe Framework Programme (HORIZON) under the Call Horizon-CL5-2022-D3-01-03 "Advanced manufacturing of Integrated PV"

COPE-Nano

2023-2029
HORIZON EUROPE
HORIZON Coordination and Support Actions

Centre Of Excellence For Organic, Printed Electronics & Nanotechnologies

1 Leading Partner and 2 Advanced Partners from 3 EU countries

This project has received funding from the European Union's HORIZON EUROPE research and innovation programme under Grant Agreement No 101059828.

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

www.smartline-project.eu

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

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

Total Budget: 4.200.000 €

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)

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

www.cornet-project.eu

H2020-NMBP-07-2017 Project (2018-2021)

Consortium: 10 Partners from 5 EU Countries (Greece, UK, Italy, France, Switzerland, Germany)

Total Budget: 3.900.000 €

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

www.apollon-project.gr

NSRF 2014-2020 Project (2018-2021)

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

www.photokipia.gr

NSRF 2014-2020 Project (2018-2021)

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 recent Research and Innovation Activities

In-line and Real-time Nano-characterization technologies for the high yield manufacturing of Flexible Organic Electronics

H2020-DT-NMBP-08-2019 Project (2020-2023)

www.realnano-project.eu

Consortium: 10 Partners from 6 EU Countries (Greece, Germany, UK, Italy, Denmark, Hungary)

Total Budget: 4.978.750 €

Main objectives

- Develop rapid and real-time nanoscale, multi- modal & scale characterization tools/ methodologies for OEs
- Integrate the non-destructive nano-characterization tools in in-line R2R printing and OVPD Pilot to Production Lines
- Develop characterization protocols and Data Management for interoperability across industries
- Demonstrate the tools in industrial OE processes for improvement of quality and reliability of products
- Validation of OE product quality and manufacturability on commercial applications
- Effective Transfer of results to industry by Open Innovation and Management

Open Innovation Ecosystem for Sustainable Nano-Functionalized Plastic and Paper Surfaces and Membranes

DT-NMBP-03-2019 Open Innovation Test Beds for nano-enabled surfaces and membranes (2020-2024)

www.flexfunction2sustain.eu

Consortium: 19 Partners from all over Europe including renowned Universities, Applied Research Organisations, and private owned Companies

Total Budget: 16.163.107 €

Main objectives

- Establish a self-sustainable Open Innovation Test Bed as an open platform for evaluation and maximisation of the innovation potential of novel ideas, technologies, and products
- Prepare technical facilities for bio- and recyclable polymers and increased reliability & cost-effectiveness
- Validate upgraded facilities in industrial use scenarios
- Define holistic innovation service portfolio aligned to SME/industrial needs and test it with early adopters
- Set up a profit company as Single Entry Point to provide common access and offer complete and transparent information about the facilities, capabilities and services provided by the Open Innovation Test Bed

LTFN recent Research and Innovation Activities

An experimentally-validated multi-scale materials, process and device modelling & design platform enabling non-expert access to open innovation in the Organic and Large Area Electronics Industry

DT-NMBP-11-2020 Project (2021-2024)

Consortium: 11 Partners

Total Budget: 4.992.000 €

Main objectives

- Develop novel validated multiscale modelling workflows for OLAE materials, processing and devices
- Develop ontology-based integrated modelling platform for workflow design, execution, data management
- Cooperation with EU stakeholders (EMMC/EMMO, Marketplaces and HPCs) for complete customer offer
- Implementation for industrial manufacturing of OPV & OLED and demonstration in application

musicode

www.musicode.eu

Harmonisation of EU-wide nanomechanics protocols and relevant data exchange procedures, across representative cases; standardisation, interoperability, data workflow

DT- NMBP-35-2020 Project (2021-2025)

Consortium: 19 partners (11 from industry and 8 academia and research)

Total Budget: 5.999.988 €

NanoMECommons will offer protocols for multi-technique, multi-scale characterisations of mechanical properties in a range of industrially relevant sectors, together with novel tools for data sharing and wider applicability across NMBP domain: reference materials, specific ontologies and standardised data documentation.

nanoMECommons

www.nanomecommons.net

LTFN recent Research and Innovation Activities

Automated Manufacturing Production Line for Integrated Printed Organic Photovoltaics

FLEX2ENERGY
AUTOMATED MANUFACTURING PRODUCTION LINE FOR IPVS

www.flex2energy.eu

This project has received funding from the European Union's Horizon Europe Framework Programme (HORIZON) under the Call Horizon-CL5-2022-03-01-03 "Advanced manufacturing of Integrated PV"

HORIZON-CL5-2022-D3-01-03 - Advanced manufacturing of Integrated PV (2023-2026)

Consortium: 15 Partners from 7 EU Countries (Greece, Germany, Hungary, Lithuania, Italy, France, Romania)

Total Budget: 21.116.625 €

Flex2Energy is a 48-month project with the ambitious goal to manufacture reliable Integrated Photovoltaics (IPVs with differentiated product design, through the development of the first-of-each-kind Automated Roll-to-Roll (R2R) Manufacturing Line for Organic PVs. The F2E Manufacturing Line consists of the R2R Printing & Automated Assembly Machines, enhanced with robust metrologies for inline quality & process control under Artificial Intelligence (AI) analysis, implementing industry 4.0 concept. F2E IPVs will comply with all the standards, codes and product requirements of use in Buildings, Agriculture and Automotive sectors.

Main objectives

- Develop and upgrade manufacturing tools for design and aesthetics of OPV products, inline process quality control techniques and easily adaptable equipment design for printed PV technologies
- Integrate tools, QC, equipment to Machines to build & demonstrate automated PL manufacturing of IPVs
- Manufacturing high efficiency, durable printed IPV products with competitive cost
- Demonstrate and Validate IPVs in energy efficient buildings, automotive and agriculture industries with minimum environmental and landscape impact
- Deploy Market Strategy and Bridge the gap between PV and Building sectors

LTFN recent Research and Innovation Activities

Centre Of Excellence For Organic, Printed Electronics & Nanotechnologies

COPE-Nano

www.cope-nano.eu

This project has received funding from the European Union's HORIZON EUROPE research and innovation programme under Grant Agreement No 101059828.

HORIZON-WIDERA-2022-ACCESS-01-01-two-stage - Teaming for Excellence (2023-2029)

Consortium: 1 Leading Partner (Greece) and 2 Advanced Partners (France, UK)

Total Budget: 30.000.000 €

COPE-Nano will create a new, autonomous, and self-sustained Center of Excellence (CoE) for Organic, Printed Electronics & Nanotechnologies by expanding the successful and innovative ecosystem of LTFN, and establishing it as leader in EU in basic, applied and industrial research in these emerging fields for applications in Advanced Materials, Energy, Electronics, ICT, AI, Medicine, Agriculture.
COPE-Nano budget is 30M€ and is funded by 50% from the EU HORIZON EUROPE program and by 50% from the Greek General Secretariat of Research and Innovation.

Impact

- Establish an autonomous and self-sustained Centre, leader in the EU
- Upgrade the scientific and technological capacity of Greece
- Economic growth to establish the Green Energy and Digital transformation
- Exploit National and European resources for strategic investments

Main objectives

- Establish COPE-Nano Organization, Governance Structure & Procedures
- Boost R&I Performance of COPE-Nano
- Enhance the Quality and Increase the R&I Output
- Promote Institutional and Systemic Reforms for increasing R&I Investments
- Boost Effective Networking with Industries & Research Institutions and Guarantee Sustainability
- Establish Investment Plan & Government Support for long-term R&I Excellence & Socio-economic Impact

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 (FPEs), covering the whole value chain of FPE Products, Services, Applications and Business.

HOPE-A scopes include:

- Development of strong links with R&D&I and Business
- Generation of new technologies, applications
- Members support to new Markets and trade-shows
- Members' Representation to International Authorities
- Distribution of information from the Markets
- Attraction of investments in FPEs and applications
- Collaboration with FPEs global entities
- Organization of Exhibitions, Workshops

HOPE-A
Hellenic Organic & Printed Electronics Association

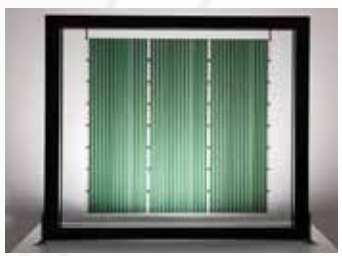
www.hope-a.com

Counting more than 30 members and bringing together more than 1500 companies Worldwide and 7 Associations on FPEs

International Collaborations

Projects





LTFN external activities & Organizations

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 750 members (Universities, Research Centers, SMEs, Industries, Hospitals) Worldwide.

Nano|Net research & innovation network

www.nano-net.gr

Nano|Net contains 7 Thematic Clusters:

Vertical Clusters

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

Horizontal Clusters

- Nanometrology, Tools, Models
- AI, ML, NanoManufacturing
- Business, Legal, Ethics, Health Safety

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.

GR NANOMED greek nanomedicine platform

www.nano-net.gr/gr-nanomed

Members worldwide

Members in Europe area

LTFN external activities & Organizations

NANOTEXNOLOGY International Conferences & Exhibition

www.nanotexnology.com

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 AI, Nano, 3D (Bio)Printing, Intelligent Manufacturing & Automation (AI3D)**
- **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 AI, Nano, 3D (Bio)Printing, Intelligent Manufacturing & Automation - AI3D

AI3D gathers innovators, experts, and researchers to a unique event about the emerging fields of 3D (Bio)Printing, Additive manufacturing, LASER processing, AI & ML in Intelligent Manufacturing and Automation, and explores new perspectives in numerous applications in our daily life.

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.

www.nanotexnology.com

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.

International Conference & Exhibition on Green Flexible Printed Electronics Industry (ICEFPE) and AGRIVOLTAICS

The **ICEFPE** International Conference & Exhibition from 2010 & **AGRIVOLTAICS** from 2022 are flagship networking annual events that bring forward the latest innovations and applications of Green FPEs to our life in

- Smart & Zero-Defect Large-Scale Manufacturing of Flexible and Printed Electronics
- Green Energy
- Energy Efficient Buildings
- Agrivoltaics Applications of Flexible and Printed Electronics
- Electric Vehicles
- Sensors & Biosensors

and other areas that **contribute to a green, digital, decarbonized industry and circular economy, society, and planet**.

www.icefpe.com

www.agrivoltaics-conf.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**

DIGITAL INNOVATION HUB
Nanotechnology Lab ltfn

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 700 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.

ICEFPE and **AGRIVOLTAICS**, international events in the fields of Green Flexible Printed Electronics Industry and Agrivoltaics, bring forward the latest innovations and applications of Green FPEs to our life.

Education & Skills Development

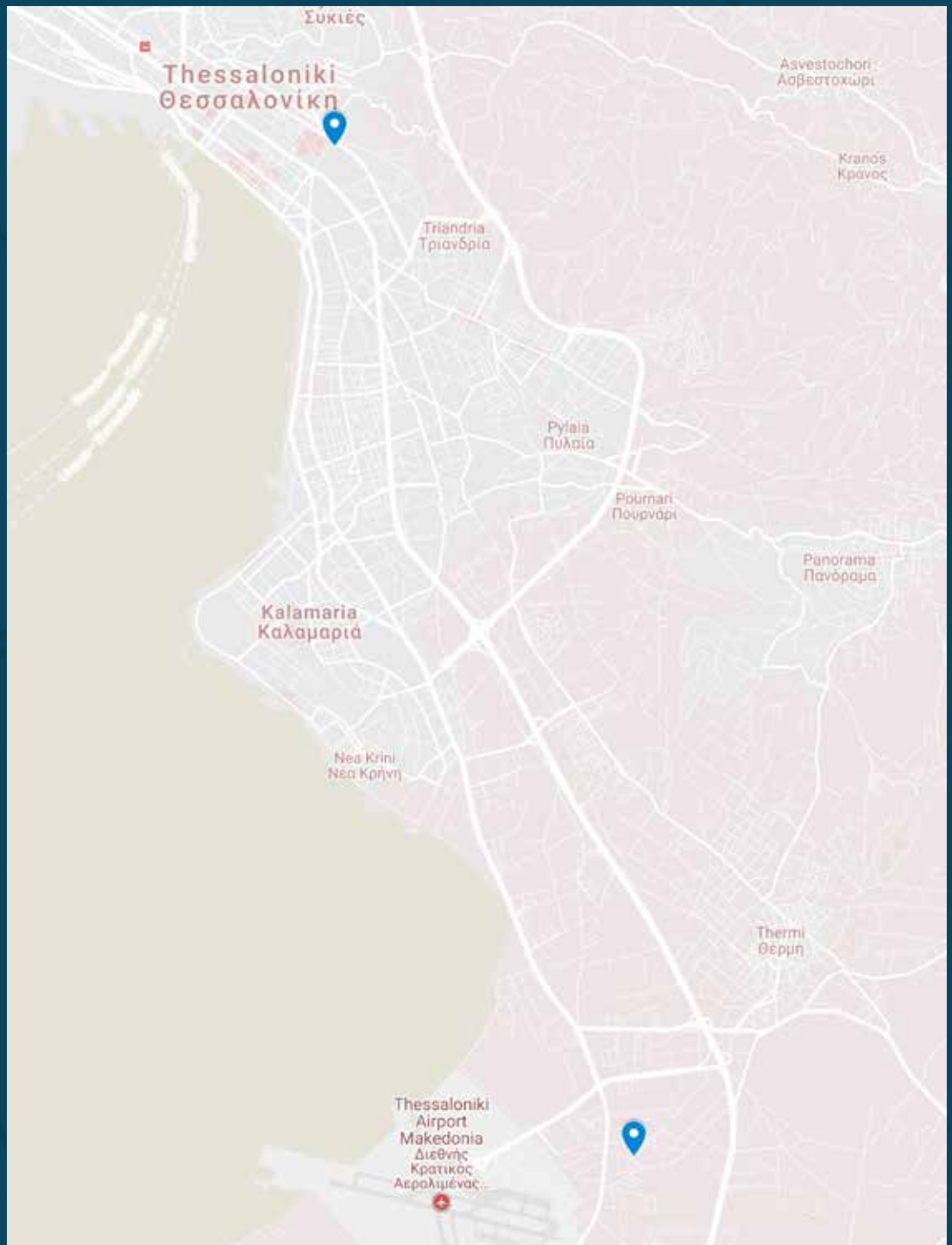
Given that the emphasis of the digital era is on the Training and Skills development of the workforce, the Nanotechnology Lab LTFN runs **Masterclasses** for Companies on its cutting-edge areas of Expertise, comprising Lectures, Demos of state-of-the-art techniques & Visits to lab facilities.

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
   Physics Dept., Aristotle
   University of Thessaloniki,
   54124 Thessaloniki

2. COPE-H facilities
   Thessaloniki airport area,
   15km Thessalonikis-
   Michanionas road, 57001
   Thermi, Thessaloniki



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ltfn Nanotechnology Lab

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