



Laboratory for Thin Films - Nanobiomaterials - Nanosystems &  
Nanometrology (LTFN)

Center for Organic & Printed Electronics – Hellas (COPE-H)

Aristotle University of Thessaloniki



The **Laboratory for Thin Films - Nanobiomaterials - Nanosystems & Nanometrology (LTFN)** is established at the Physics Department of Aristotle University of Thessaloniki (AUTH). It has an experience of 25 years in Thin films Technology, Fabrication of nanostructured materials & nanoparticles, developing/deploying in-situ & real-time monitoring techniques, modeling and Nanometrology. LTFN programs strive to interact with Academia, Research Institutes and Organizations and Industry and to transfer its technology to scientific and industrial users and developers and provide excellently educated graduates and research associates to society.

#### RESEARCH ACTIVITIES & COMPETENCES

- **Organic & Printed Electronics:** Materials & Processes for Flexible Electronic Devices, OPVs, OTFTs, OLEDs, Biosensors, Printed Transparent electrodes and Barrier layers
- **Thin Films, Nanomaterials & NanoEngineering:** Thin Films, Nanoparticles, Device Microfabrication with Vacuum and Printing techniques, Systems Design and Process monitoring Nanopatterning by Ultra-fast Laser, Ion-beam and Plasma processes, Surface characterization, Nanomechanical response, Surface activation and functionalization
- **Nanomedicine & Nanobiotechnology:** Biocompatible nanomaterials, Development of drug delivery nanosystems, Nanoparticles synthesis and characterization, Scaffolds & nanoporous materials for implants, Bio-Functionalization, Haemocompatibility & Cytocompatibility tests
- **Optical Technology & Nanometrology:** In-line optical monitoring of Printing & Vacuum Processes, Nanometrology applications and Non-destructive characterization, Ellipsometry & Raman
- **Computational & Modeling at Nanoscale:** First Principles Calculations, Modeling of Devices and Processes, Study of the electronic, optical & mechanical properties of materials

#### TECHNOLOGIES & APPLICATIONS

- **Organic Electronics:** OLEDs for displays and lighting, OPVs, OTFTs, sensors RFID
- **Energy:** OPVs for electricity generation, OLED lighting for energy efficiency Wearables: smart textiles with energy and lighting functionalities
- **Wearables: smart textiles with energy and lighting functionalities**
- **Buildings:** energy efficient buildings, lighting, tents, roofs
- **Automotive:** energy generation and autonomy, solar roofs
- **Agriculture:** energy efficient Mediterranean Green-houses by OPVs & OLEDs
- **Smart Packaging:** food, consumer products, pharmaceutical products
- **Nanomedicine:** stents, orthopaedic implants, contact lenses, biosensors etc.
- **Information Technology:** Organic Electronics, Micro- electronics, Optoelectronics and Optics, Storage and Displays, Micro – fabrication

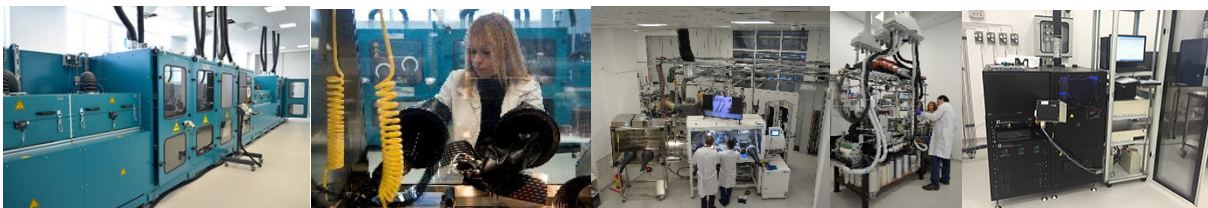
#### Facilities / Infrastructure

LTFN has a long time experience and expertise in Thin Film Technology, Organic Electronics and Nanometrology and Nanobiotechnology that shows its capacities, and guarantees the successful realization of the activities.

LTFN has a state-of-the-art research infrastructure that includes:

- R2R pilot line with Slot die coating, Inkjet and Rotary Screen printing techniques for the fabrication of OE devices, The R2R pilot line is also equipped with ultra-fast pulsed laser for device patterning and in-line optical metrology tools for quality control.

- S2S pilot line with Inkjet printer, & Slot die coater, Plasma treatment, Thermal Evaporator, Spin Coating systems and solar simulators in N<sub>2</sub> filled glove boxes for nanomaterial fabrication on up to A4 size substrates.
- OVPD Pilot Line equipped with 6 sources, handler, metallization chamber, glove box and flip-top chamber for the fabrication of OE devices (e.g. OPVs, OLEDs, sensors, etc.). This pilot line is also equipped with in-situ and real-time optical sensing techniques (Spectroscopic Ellipsometry-SE, Raman Spectrometer-RS) for the robust quality control of the deposited materials and devices.
- CVD system for the deposition of graphene and other carbon based nanomaterials onto 6 inch diameter substrates, equipped with in-situ and real-time optical sensing techniques (SE, RS).
- State-of-the-art UHV and HV deposition systems with adapted real-time optical sensing techniques and several growth techniques (thermal evaporation, magnetron sputtering, e-beam evaporation, ion beam assisted deposition, PVD etc.)
- Several characterization facilities (6 SE units from IR to fUV), Lab for mechanical, structural properties & nanotopography, AFM, SNOM, Contact Angle, XRD, XRR, electrical measurements, NanoIndentation, 4 Raman Spectrometers, H<sub>2</sub>O & O<sub>2</sub> permeation systems for barrier measurements, XPS, Auger, SEM, TEM.



## SERVICES

- Organic Electronics materials (organic semiconductors, transparent electrodes, barriers, plasmonic nanoparticles, etc.) and devices (OPVs, OLEDs, OTFTs, Sensors, Biosensors)
- Novel thin film and multifunctional layers
- Roll-to-Roll printing of Organic Electronic devices
- Gas transport and CVD processes for films and 2D materials
- Materials Patterning by ultra-fast laser processes
- Encapsulation methodologies and processes
- Design of novel optical sensing systems and non-destructive characterization techniques
- Microstructural & nanomechanical characterization
- Optical Engineering, & Computational Modelling
- Nanobiotechnology & Nanomedicine (Protein-Enzyme-DNA surface adsorption, surface biocompatibility, characterization of biomaterials)
- 

## R&D PROJECTS

1. **H2020 NMBP-07-2017 Project:** Multiscale modelling and characterization to optimize the manufacturing processes of Organic Electronics materials and devices (CORNET)
2. **H2020 FOF-07-2017 Project:** Smart in-line metrology and control for boosting the yield and quality of high-volume manufacturing of Organic Electronics (SmartLine)
3. **FP7 NMP Large-scale integrating Project:** "Development of smart machines, tools and processes for the precision synthesis of nanomaterials with tailored properties for Organic Electronics" (**Smartonics**), NMP.2012.1.4-1, Grand Agreement 310229)
4. **FP7 NMP IP Large-scale integrating Project:** "Graphene Layers: Production, Characterization and Integration" (**Gladiator**), NMP.2013.4.0-1, Grand Agreement no. 604000
5. **BASMATI- H2020 - NMP - PILOTS 2014:** "Bringing Innovation by Scaling up nanomaterials and inks for printing", Grand Agreement no.646159
6. **FP7 Research Potential (REGPOT-2011-1) Project:** "Reinforce Organic Electronics Research Potential in Kentriki Makedonia" (**ROLEMak**) (2011-2014)

## REPRESENTATIVE PUBLICATIONS

- 1. Achieving 6.7% Efficiency In P3HT / Indene-C<sub>70</sub> Bisadduct Solar Cells Through The Control Of Vertical Volume Fraction Distribution And Optimized Regio-Isomer Ratios**  
D. Kutsarov, I. Rašović, A. Zachariadis, A. Laskarakis, K. Bruchlos, K. Porfyrakis, M. Beliatis, C. Mills, B. Fisher, S. Ludwigs, S. Logothetidis, S. Ravi P. Silva  
Adv. Electron. Mater. 2016, 1600362
- 2. A comprehensive study of the optical properties of emitting polymers for efficient flexible OLED devices**  
M. Gioti, C. I. Chaidou, D. Kokkinos, A. Laskarakis, A.K. Andreopoulou, J.K. Kallitsis, S. Logothetidis  
Phys. Status Solidi A, 1–7 (2016)
- 3. Universal Compact Model for Organic Solar Cell**  
J. W. Jin, S. Jung, Y. Bonnassieux, G. Horowitz, A. Stamateri, C. Kapnopoulos, A. Laskarakis, S. Logothetidis  
IEEE Transactions on Electron Devices, DOI 10.1109/TED.2016.2598793 (2016)
- 4. Gravure printed organic photovoltaic modules onto flexible substrates consisting of a P3HT:PCBM photoactive blend**  
C. Kapnopoulos, E. D. Mekeridis, L. Tzounis, C. Polyzoidis, S. Tsimikli, C. Gravalidis, A. Zachariadis, A. Laskarakis, S. Logothetidis  
Materials Today: Proceedings 3 (2016) 746 – 757
- 5. Handbook of Flexible Organic Electronics: Materials, manufacturing and applications**  
Woodhead Publishing December 2014, ISBN 9781782420354, editor S. Logothetidis
- 6. Fully gravure printed organic photovoltaic modules: A straightforward process with a high potential for large scale production**  
C. Kapnopoulos, E. D. Mekeridis, L. Tzounis, C. Polyzoidis, A. Zachariadis, S. Tsimikli, C. Gravalidis, A. Laskarakis, N. Vouroutzis, S. Logothetidis  
Solar Energy Materials and Solar Cells, 144 (2016) 724-731.
- 7. Non-destructive optical characterization of phase separation in bulk heterojunction organic photovoltaic cells**  
D. Georgiou, A. Laskarakis, M. Morana, P.G. Karagiannidis, S. Logothetidis  
Solar Energy Materials and Solar Cells, Volume 125, June 2014, Pages 190–197

## OUTREACH ACTIVITIES

LTFN organizes annually the Multi-event NANOTECHNOLOGY: ([www.nanotechnology.com](http://www.nanotechnology.com)) in Thessaloniki, Greece that includes the internationally established events:

- International Symposium on Flexible Organic Electronics (ISFOE) (<http://isfoe.physics.auth.gr>)
- International Conference on Nanosciences & Nanotechnologies (NN) (<http://nnconf.physics.auth.gr>)
- International Summer Schools on N&N "NN, Organic Electronics & Nanomedicine" (ISSON) (<http://isson.physics.auth.gr>)
- NANOTECHNOLOGY EXPO (<http://www.nanotechnologyexpo.com/>)

## NETWORKING ACTIVITIES – NANONET ([www.nano-net.gr](http://www.nano-net.gr))

LTFN coordinates from 2003 the Thematic Network NANONET ([www.nano-net.gr](http://www.nano-net.gr)) with more than 400 individual members worldwide and more than 900 cluster members covering the fields of Nanobiosciences & Nanotechnologies. **Nano|Net** is an initiative for the promotion of communication and collaboration between research and business organizations activated in the fields of Nano-Bio-Technologies. Its' main purpose is to reinforce and promote Nanotechnologies in Greece, Europe and Worldwide, through an interscientific approach. **Nano|Net** started in 2003 from [Nanotechnology Lab LTFN - AUTH](http://www.nanotechnologylab.auth.gr), counting more than 520 individual members (~1100 cluster members) worldwide (including University Labs, Research Institutes, Companies, Hospitals etc).

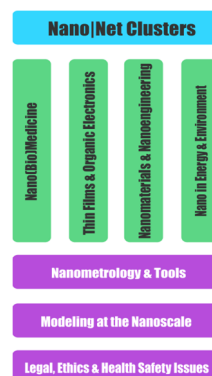
**Nano|Net** is an International Network with multidisciplinary and polythematic role, aiming to merge the existing expertise and knowledge between the rapidly growing fields of **Nanotechnologies** and **NanoBiotechnologies**. **Nano|Net** includes four Vertical and three Horizontal Clusters.

#### Vertical Clusters

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

#### Horizontal Clusters

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



#### HELLENIC ORGANIC AND PRINTED ELECTRONICS ASSOCIATION (HOPE-A) ([www.hope-a.com](http://www.hope-a.com))

LTFN coordinates the Hellenic Organic and Printed Electronics Association (HOPE-A) ([www.hope-a.com](http://www.hope-a.com)) HOPE-A is the Hellenic Organic and Printed Electronics Association. HOPE-A organizes and co-ordinates the activities of industrial and research institutions in Greece in the field of Organic & Printed Electronics and strengthen their goals. The Scopes of the HOPE-A include:

- Create a network of companies working in the organic and printed electronics applications
- Develop strong links between R&D, technology and manufacturing
- Generate new technologies, applications, roadmap and reports
- Support members to new markets and trade-shows
- Strengthen contacts with public authorities
- Distribute information from the markets
- Enhance the attraction of funding and investments for the members
- Strengthen the collaboration with organic and printed electronics global organizations and companies
- Organization of Exhibitions, Workshops, Seminars and training activities

#### Contact:

Professor S. Logothetidis

Lab for Thin Films, Nanobiomaterials, Nanosystems & Nanometrology (LTFN)

Physics Department, Aristotle University of Thessaloniki

Thessaloniki, 54124, Greece

e-mail: [logot@auth.gr](mailto:logot@auth.gr)

tel: +30 2310 998174

fax: +30 2310 998390