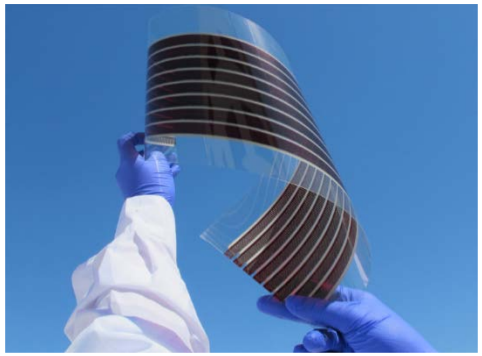
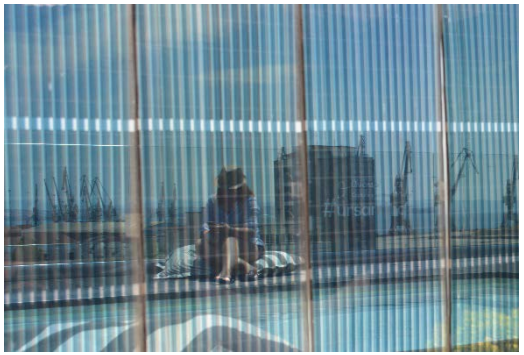
Novel Pilot Lines and TestBeds for Reliable Large Scale Manufacturing of Organic & Printed Electronics (OE)






Stergios Logothetidis
logot@auth.gr

Nanotechnology Lab LTFN
Center for Organic & Printed Electronics – Hellas (COPE-H)
logot@auth.gr www.ltfn.gr

OE-Technologies
www.oe-technologies.com

ORGANIC ELECTRONIC TECHNOLOGIES

BL NanoBiomed P.C.
www.bl-nanobiomed.com

www.smartonics.eu

"Development of Smart Machines, Tools & Processes for Nanomaterials with Tailored properties for Organic Electronics" (Smartonics) (2013-2016)

Outline

- Brief Introduction of LTFN/COPE-H & Pilot Lines
- Offered Services & Products
- Expectations on EPPN
- Action Plan to Attract Users & Outside Clients
- Business Units Established
- Plans for Continuation/Attraction of Funds and National/Regional Programmes

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

Aristotle University of Thessaloniki, Greece (www.ltfn.gr)

Founded by **Prof. S. Logothetidis** in 1991

- **Multidisciplinary Team of 45 Expert Scientists in 2500 m² of Lab Space**
- **Industrial Association HOPE-A** with **>300 Entities** (**hope-a.com**)
- **Thematic Network Nano-Net** with **>570 Entities** (**nano-net.gr**)
- **10 Pilot Lines**
- **Digital Innovation Hub, Investment by EIB (>50 M€) for Extension**
- **OET and BL Nanomedicine SMEs**

LTFN & OET Teams




Core Competences & Excellence

- **Organic & Printed Electronics & Photonics (4PL)**
- **Thin Film Technologies & Nanoengineering (4PL)**
- **Nanomedicine (2 Pilot Lines)**
- **Nanometrology & Optical Technology Labs (TB)**
- **Computational & Modelling at Nano- to Micro-Scale**

Nano- Manufacturing by 2 R2R & 1 S2S Pilot-Production Lines

- **Digital Printing** (Gravure, Slot die, Inkjet, Screen)
- **In-line Metrology** for Quality Control & **Ultra Fast Laser for Scribing**
- **Encapsulation Solutions**

Nano- Manufacturing by OVPD & CVD Pilot Lines

- **OVPD for Scalable Manufacturing**
- **Unique CVD Pilot Line** for controlled growth of 2D Materials
- **In-situ Metrology for Quality Control in all Pilot Lines**

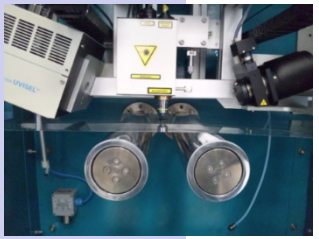
Nano- Manufacturing of Novel Devices & Systems

- **Organic & Printed Electronic and Photonics Devices (**OPVs, OLEDs, OTFTs, Sensors, Biosensors, RFIDs, etc)
- 2D & Functional Materials (optoelectronic, antimicrobial,

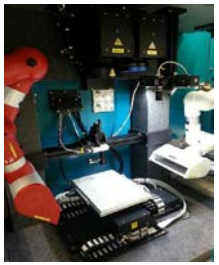
High Impact Applications

- Electronics, Energy, Automotive, Wearables, IoT,
- Buildings, Medicine, Agriculture, Industry 4.0
- Circular Economy, Digital Nano- Manufacturing

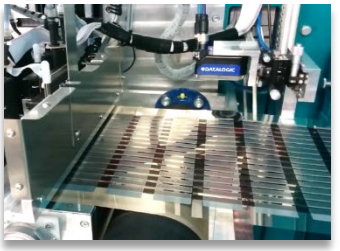
In-Line Precision Metrology



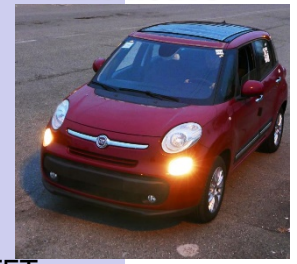
In-Line Laser



Digital Nanomanufacturing



Automotive



Greenhouses

smartonics

Smart line

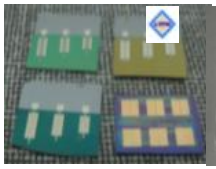
FoF Factories of the Future Public Private Partnership

CORNET

Wearables

OPVs, OLEDs, Photonics

OTFTs



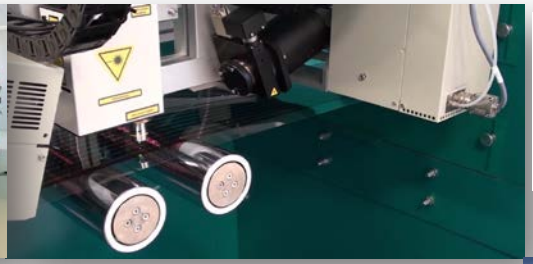
Biosensors

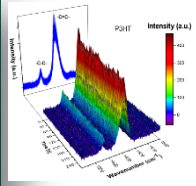
EU FP7 Smartonics Project: A Success Story

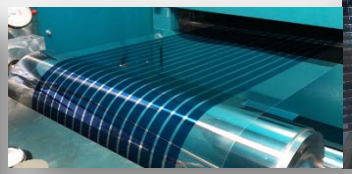
NMP.2012.1.4-1 Large-scale Integrating Project

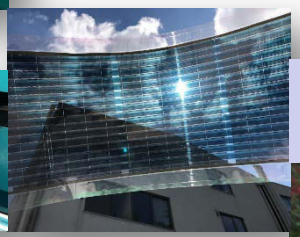
Development of smart Machines, Tools and Processes for the Precision Synthesis of Nanomaterials with Tailored Properties for Organic Electronics (Smartonics), 2013-2016

Consortium: 18 from 6 EU Countries
Budget: 11.5 M€ (7.9 M€ from EC)
Coordinator: LTFN/AUTh









EU Best Project Award
1st Runner-up

Unique Pilot to Production Lines & TestBed for OEs Manufacturing

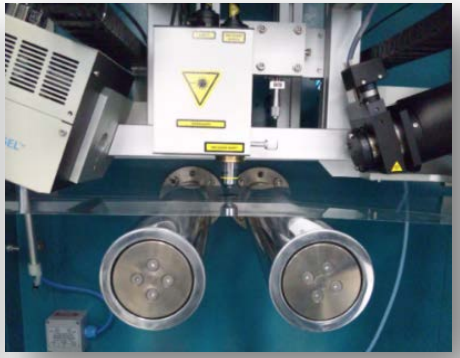
R2R Pilot Line equipped with Precision Metrology & Patterning Tools

OVPD Pilot Line equipped with Precision Metrology Tools

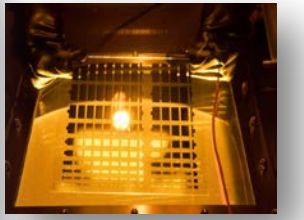
Collaborative Work: AUTh, OET, Horiba, Coatema, Compucon, AIXTRON

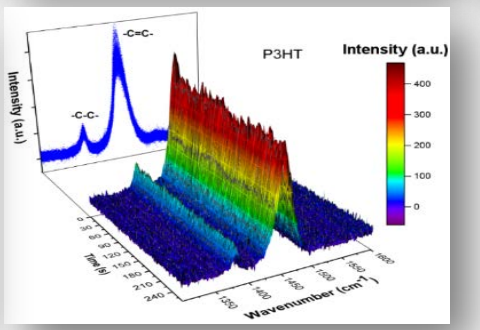
Ultra Fast Laser System

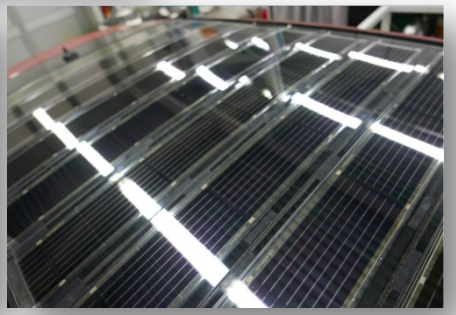
In-line Optical Metrology



In-line Ink-jet Printer







Services / Products Offer

- **Open Access to interested Entities** (Academia, Research, SMEs, Industries)
- **Test Bed for Characterization, Modelling, Production** of OE Material/Device/Products
- **One-Stop-Shop for SMEs** (Proof-of-concept, Incubation) **and End User SMEs**
- **Foster Links with Industrial & Public Ecosystems** (Associations, Networks, etc)
- **Promote Access to Funding for Product Development**

From Lab Scale Fabrication…

- **Lab Scale Process and Fabrication** of novel Device Concepts (OPVs, OLEDs, (Bio) Sensors, OTFTs)
- **Screening/Design/Simulation/Testing** of Nanomaterials & Device Concepts (Lab to Large area)

To Tools …..

- **Ultra-fast Laser Processes** for Scribing/Structuring/Ablation of wide range of surfaces
- **In-line/Real-tme Metrology Solutions** (Optical/Electrical/Interferometric) for Quality Control of Processes
- **Metrology Solutions** (In-Line, Ex-Situ) for Material, Devices & Product Optimization

To Encapsulation Concepts of Devices (from Small to Large Scale)

To Large Scale Processes and Manufacturing

- Development of large scale Process & Manufacturing OPVs, OLEDs, OTFTs, (Bio) Sensors, etc.
- Integration of OE Devices and Modules to innovative Commercial Products

To Applications in Energy, Automotive, Buildings, Greenhouses, Wearables, IoT, Health

Conditions & Benefits

Conditions

- **Signature of NDA, MoU**
- **Establish Framework for IPR** Management & Protection (background, foreground)
- **Budget Plan & BPlan to Cover Costs** of Materials, Consumables, Personnel, Training, use of Facilities, Depreciation, Testing, Networking, Support
- **Health & Safety Assessment** and Ethics Clearance
- **Sustainability Plan** for long term Growth

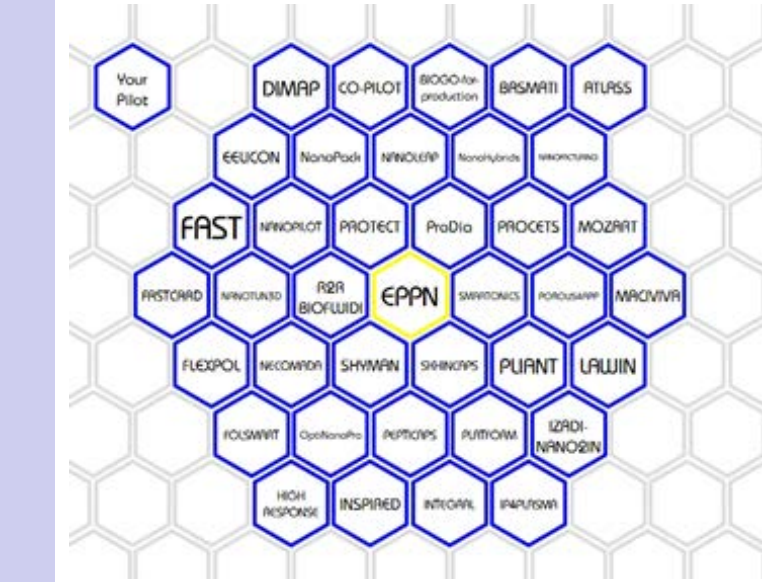
Benefits

- Solve Industrial Problems in Material/Device/Process/Product Manufacturability & Reliability
- Induce Novel & Unprecedented Functionalities & Intelligence to Products
- Upscale novel Product Concepts
- Connect and Collaboration with other entities in Regional, National, EU and World levels
- Reduce time-to-Market for new Products
- Faster route to Commercialization

Expectations on EPPN

- **Network LTFN Pilot Lines with Complementary Facilities in EU**
- **Promote Pilot Lines to EU & World** Networks, Associations, Members
- **Support for IPR Management & Patenting**
- **Provide Contact with interested Stakeholders** (SME, Industries, RTOs) to establish Collaborations
- **Promote Actions to Policy Makers** in National/Regional/EU levels
- **Connect with Funding Bodies** (Public, Private, VC)
- **EPPN to Represent LTFN Pilot Lines in Events**

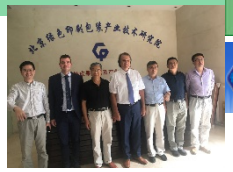
- **Organize Physical Meetings of the EPPN Working Groups in combination to International Events**
- **We Propose WG Meeting & Special Session in NANOTEXNOLOGY 2018 (Thessaloniki, 30/6-7/7/2018) to Connect to >1200 Participants (Industries, SMEs, RTOs, Funding Bodies, etc.)**



Action Plan to Attract Users & Outside Clients

- **Bilateral Contacts for Collaborations** (to Academia, Research, SMEs, Industries)
- **Establishment of New & Expansion of Industrial Associations (HOPE-A)**
- **Thematic Networks (NanoNet)**
- **Dissemination & Outreach Activities (NANOTEXNOLOGY)**
- **EU Projects, TestBeds, DIHs & Platforms**

Hellenic Organic & Printed Electronics Association (HOPE-A)
Connects > 300 Companies Worldwide
www.hope-a.gr


2018 nanotexnology
30 JUNE-7 JULY 2018, THESSALONIKI, GREECE
INTERNATIONAL CONFERENCES & EXHIBITION ON NANOTECHNOLOGIES - ORGANIC ELECTRONICS & NANOMEDICINE

15 Years in Thessaloniki with >1200 Participants from 60 Countries Every Year!

Research & Innovation Network NanoNet (www.nano-net.gr)

NanoNet research & innovation network
GR NANOMED greek nanomedicine platform

570 Organisations (Universities, Research Centers, Companies, Hospitals)

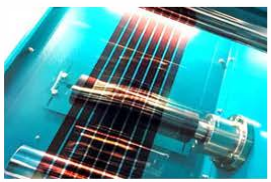
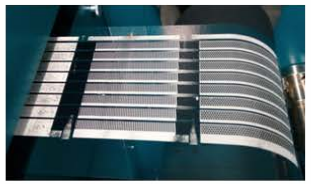
- **225 from Greece**
- **253 from Europe**
- **38 from USA and Canada**
- **39 from Asia**
- **105 Companies**
- **10 Hospitals**

Organic Electronic Technologies (OET)

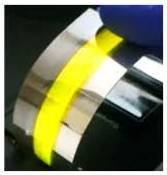
- **SME** Company, Founded in 2012
- Member of **OE-A** & **HOPE-A** Association

ORGANIC ELECTRONIC TECHNOLOGIES

www.oe-technologies.com


R2R OPV production



R2R OLED manufacturing

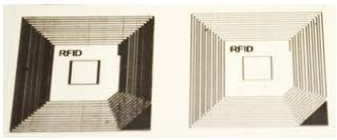
OET
Start-up Company
Founded in 2012

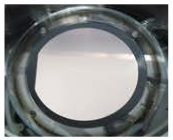




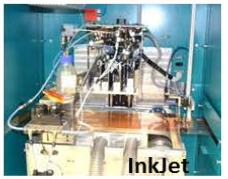


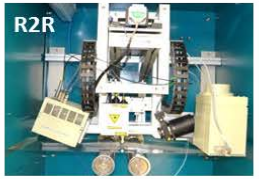
Applications of OPVs

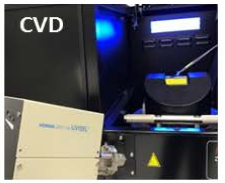





R2R NanoCarbon tubes & RFIDs, Graphene







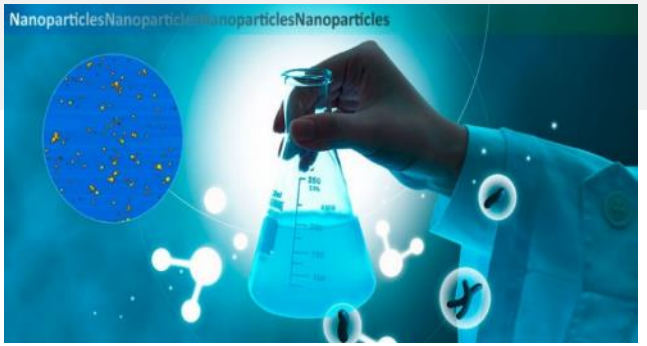
Development of in-line Laser, Printed Systems and Metrology Tools

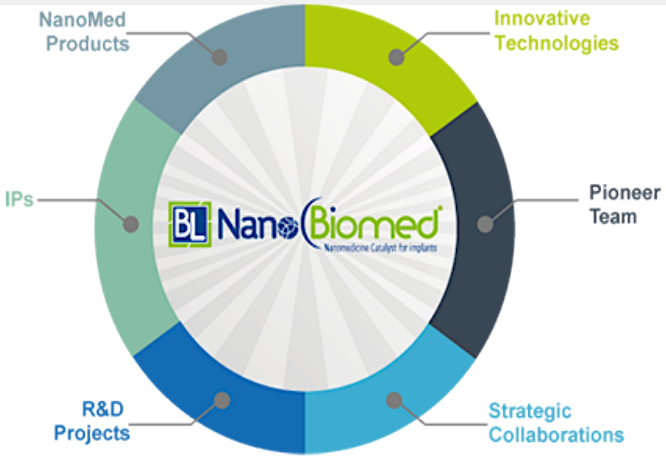
BL Nanobiomed

- Spin-out Company of Nanotechnology Lab LTFN
- Established 2014, in Nanomedicine to Treat Diseases (like Cardiovascular, Osteoarthritis, Cataract), for Drug Delivery Systems, Biosensors, etc

BL Focus on the:

- Development of Novel Nanotechnologies for Health and Bioelectronics
- Manufacturing Processes for Drug Eluting Nano-systems (Stents, Orthopedic Implants, Lenses)
- IPs, Technology Licensing and Technology Transfer





Core Activities

- Design
- Development
- Prototyping
- Production
- Commercialization

Products

- NanoStents
- Nano-Orthopedics
- NanoLenses

Continuation & Sustainability Actions 2017-2021

H2020 FOF Project: Smart in-line Metrology and Control for Boosting the Yield and Quality of High-Volume Manufacturing of OEs (SmartLine)

- Partners: **AUTh**, OET, CRF, IBS, Laytec, Suragus, AIXTRON
- 01/09/2017-30/8/2020
- Budget: 4.262 K€
- **http://smartline-project.eu**

Factories of the Future Public Private Partnership

HORIZON 2020

FOF-07-2017

H2020 NMBP Project: Multiscale Modelling & Characterization to Optimize the Manufacturing Processes of OEs Materials and Devices (CORNET)

- Partners: **AUTh**, CRF, Granta, USUR, OET, Fluxim, CNRS, AIXTRON, NPL, HOPE-A
- 01/2018-12/2020
- Budget: 3.998 K€
- **http://cornet-project.eu**

HORIZON 2020

NMBP-07-2017

LTFN: Digital Innovation Hub, Initiates the Greek Smart Industry

Smart Industry

ltfn Nanotechnology Lab

HOPE-A Hellenic Organic & Printed Electronics Association

NanoNet research & innovation network

Visit of Greek Minister for Digital Policy (8/9/2017)

Plans for Continuation: Submission of New Proposals in 2018

- **DT-NMBP-07-2018: Open Innovation Test Beds for Characterisation (IA)**
  Develop an Open Innovation Test Bed on multiscale & multimodal characterization, and industrial-one of Properties and Stability for Organic and Printed Electronics & Photonics (OEP) devices for industrial applications.
- **DT-NMBP-01-2018: Open Innovation Test Beds for Lightweight**, nano-enabled multifunctional composite materials and components (IA)
  Open Innovation Test Bed on fabrication of intelligent lightweight nano-enabled composite Organic Electronic & Photonic materials and components by digital nanofabrication (printing) & in-line metrology
- **NMBP- 22-2028 Osteoarticular Tissue Regeneration Nanomedicine**
  Nanofabrication of novel biomaterial-construct for osteoarticular tissue regeneration
- **DT-FoF-03-2018: Innovative manufacturing of opto-electrical parts (RIA)**
  Innovative production lines for manufacturing of OPV and other printed opto-electronic components

……

- **ICT-02-2018: Flexible and Wearable Electronics**
- **ICT-04-2018:** Photonics based manufacturing, access to photonics, ..photonics and connected lighting: **Tailored Laser Beams for Laser Based Manufacturing**
  Novel laser technologies and processes for intelligent Nanomanufacturing of OE & Photonics components & devices
- **DT-ICT-07-2018:** Digital Manufacturing Platforms for **Connected Smart Factories**
- **ICT-07-2018:** Electronic Smart Systems: **Bioelectronics**
- **ICT-27-2018-2020:** Internet of Things

Plans for Continuation: EKNOH Center

Extension of LTFN to
National Center for "Nanotechnologies, NanoMedicine & Organic Electronics" (EKNOH)

To be Funded by: EIB Bank (>40 M€) & Ministry of Funds (>10M€)

Duration: 2018-2022

European Investment Bank

500 m²

4.500 m²

10.000 m²

EKNOH Institutes

- Organic & Printed Electronics & Photonics
- Inorganic Nanomaterials, Nanoelectronics, Nanosystems & Nanoengineering
- Nanomedicine
- Agro-Nano
- Technology Transfer & Innovation

- **Area: 4.500 m² (Building B), 10.000 m² (Building C)**
- **Personnel (2023): ~480 (Prof., Proj. Managers, Scientists, IPR etc.)**
- **Expected Revenues (2023): >110 M€**
- **New Start-Ups: >100**
- **Incubation Services: to SMEs, Companies**
- **Open Access: to Facilities, Pilot Lines, TestBeds**

Plans for Continuation: