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nanoscience foundries & fine analysis

Tools for the nanosafety users: The FORTH experience

Emmanuel Stratakis

FORTH

FORTH

NFFA-Europe Nanosafety Workshop, Lund, Jan. 9-10 2020

NFFA-Europe has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654360

Nanomaterials Safety in EU

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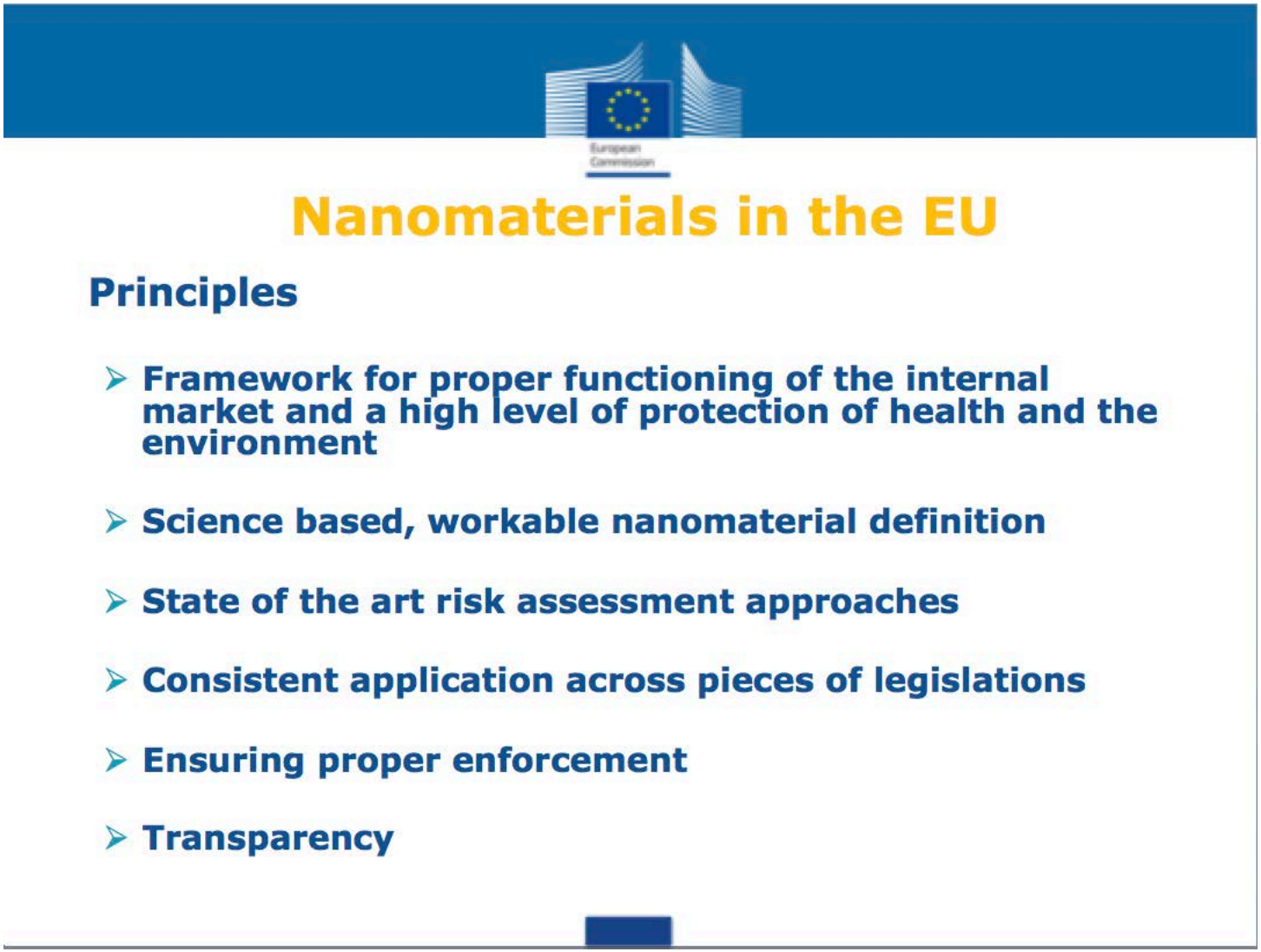
Nanomaterials in the EU



Courtesy of Dr. G. Katalagarianakis

The Seed

Research on Nanomaterials Safety:
Is there sufficient hazard/exposure/risk to warrant changes in regulation at a European Level ???

If YES then “we should update regulations to make them suitable for nanomaterials.”

EU nanosafety research policy basics

Courtesy of Dr. G. Katalagarianakis

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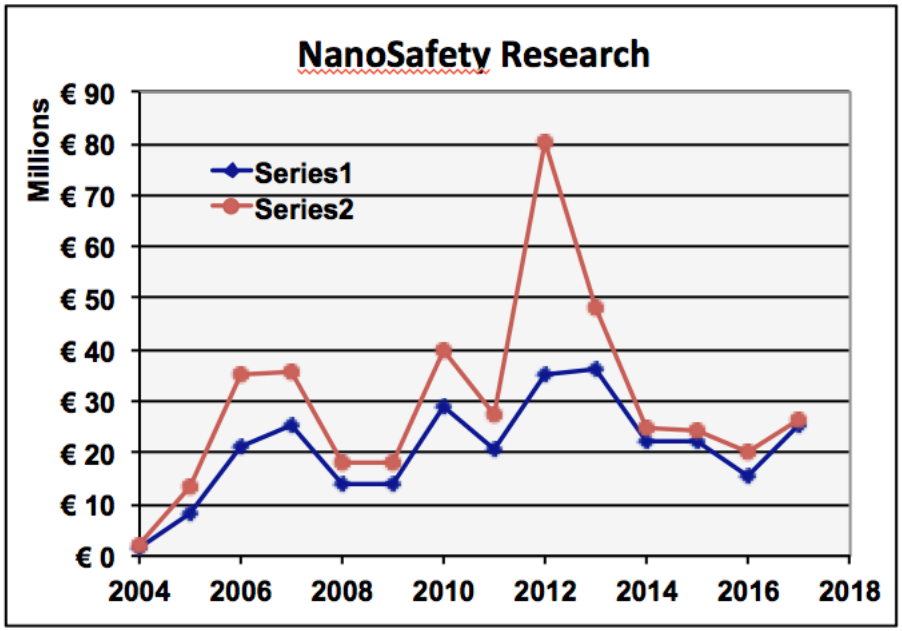
Nanosafety Research in EU

Nanosafety research in FPs and H2020 Investment



NB: These figures do not include safety research in application-oriented projects nor nanomedicine

Courtesy of Dr. G. Katalagarianakis

Key initiative: Nanosafety Cluster

STRATEGIC DIRECTION ENHANCING SYNERGIES

A high profile platform for the coordination of nanosafety research in Europe

Providing strategic direction for the EU and member states

Training

Innovation

Safer by design

Policy & Regulation

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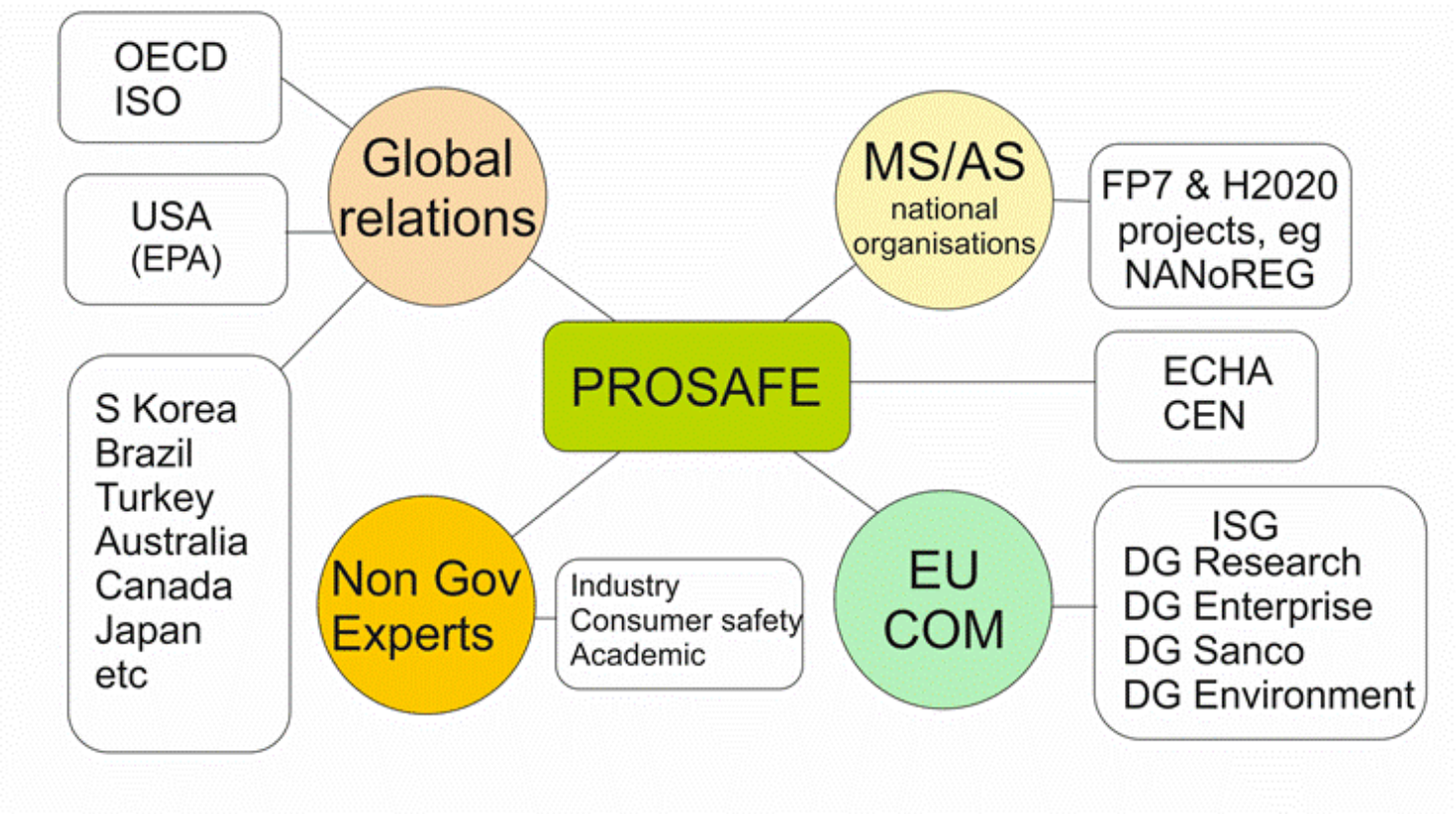
www.nanosafetycluster.eu

FORTH participation

A common European approach to regulatory research on risk assessment of nanomaterials



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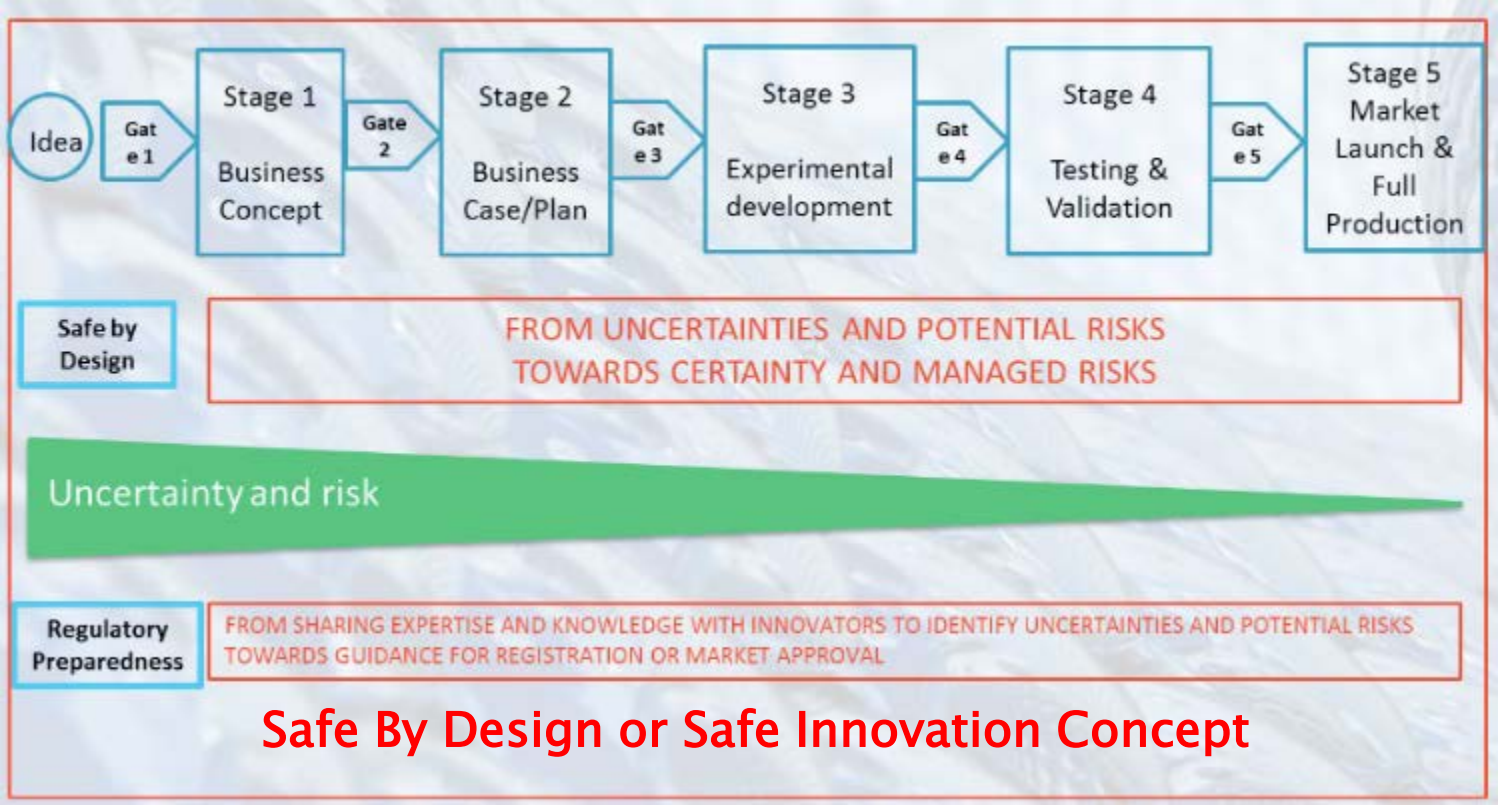
FORTH participation

NanoReg2

Nanoreg2 establish **Safe By Design** as a fundamental pillar in the validation of a novel manufactured material

How to bring (high or unknown) risk back to acceptable level ?



Safe By Design or Safe Innovation Concept

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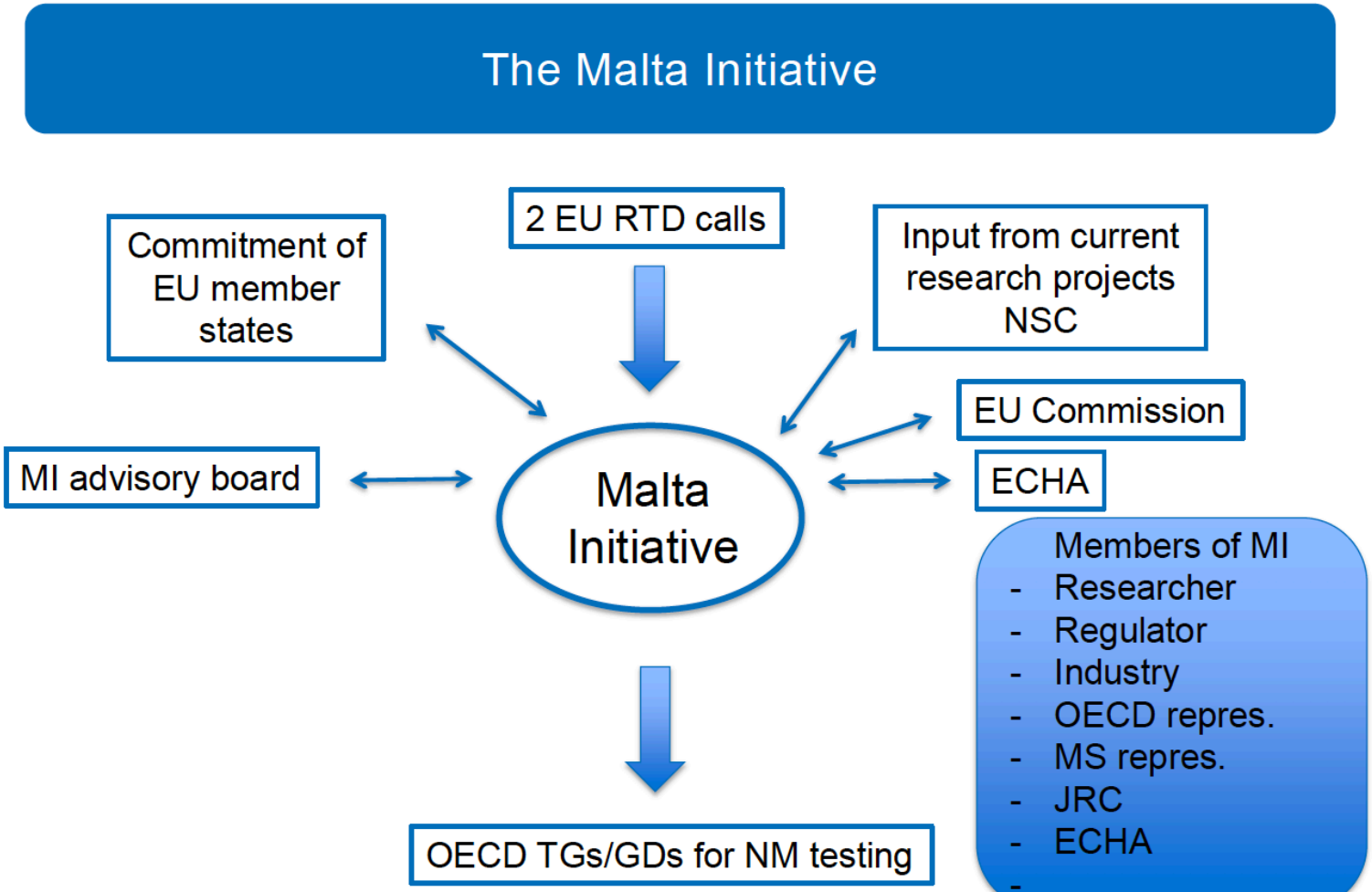
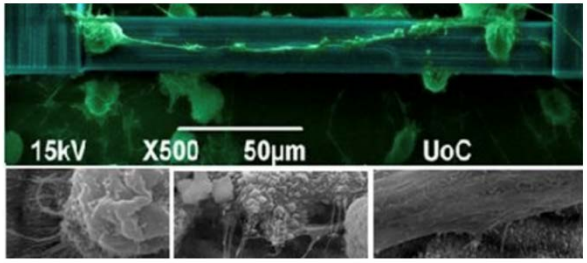
FORTH participation



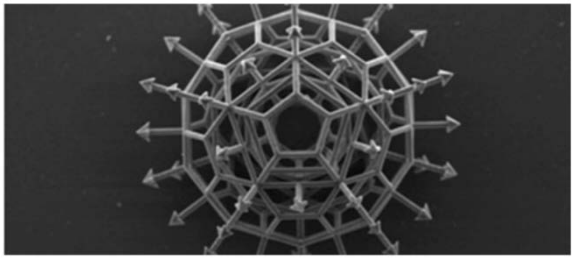
Nanosafety-related TNA Offer at NFFA-FORTH

SOFT MATTER PREPARATION



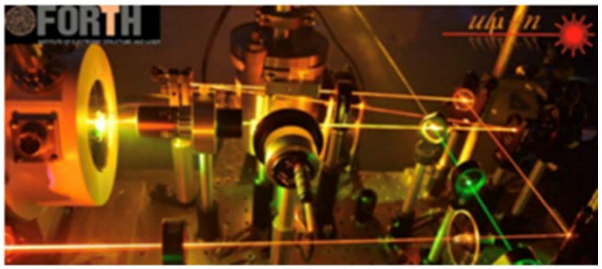
This service includes different chemical processing platforms to prepare nanomaterials or self-assembled systems: organic, hybrid organic-organic,organic-inorganic or biomolecule-organic systems, and biomaterial systems; under various forms, such as colloidal dispersions (nanovesicles, nanosuspensions, nanoliposomes...), solid micro- and nanoparticulate powders (crystalline solids,

TWO-PHOTON LITHOGRAPHY



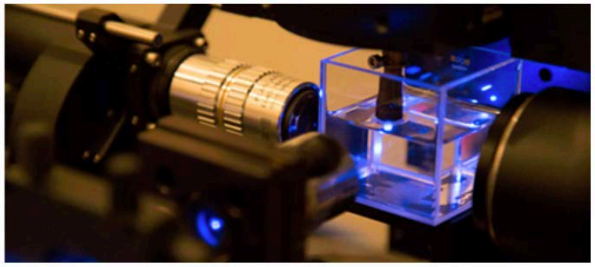
High resolution 2D and 3D structuring process of a photosensitive material by means of physical and chemical changes produced in the focusing area of an ultrashort pulse laser of sufficiently high light intensity. 2D resist mask-less patterns, or polymeric micro-parts with a 3D shape can be obtained by scanning the photoresist relative to the beam focus submicron. Features of a

LASER SURFACE AND IN-VOLUME PATTERNING



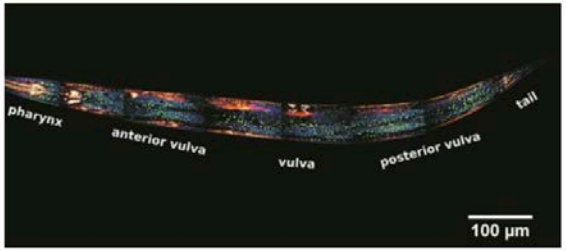
Laser patterning is a material independent technique for the controlled patterning of materials at the both the micro- and the nano- length scales. The technique offers the ability to directly write patterns on the surface as well as complex 3D channels into the bulk of solid materials, including biomaterials. Various

FLUORESCENCE MICROSCOPY
HYBRID TOMOGRAPHIC AND LIGHT SHEET FLUORESCENCE MICROSCOPY



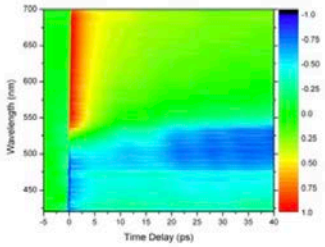
The hybrid Optical Projection Tomography and Selective Plane Illumination Microscopy (OPT-SPIM) is used to produce optical sectioning of molecular

LASER SCANNING CONFOCAL MICROSCOPY



This technique has the mission of enabling researchers to visualise and to monitor cellular events in real time and in vivo down to the molecular level, enabling prolonged observations that are not possible with classic confocal microscopes and allowing unparalleled detail in soft matter imaging

PUMP-PROBE



The pump-probe spectroscopy infrastructure provides in-situ probes of the excited state of the matter, i.e. in the time/frequency domain at the fs-ps scales.

Tools for the nanosafety users at FORTH

1	Synthesis of Novel Biomaterials for Tissue Regeneration, Biosensing and Drug Delivery
2	Precision Fabrication of Biomimetic Micro/Nano Cellular Scaffolds and Bio-Microfluidic Platforms
3	Nanomaterials' Synthesis and Functionalization for Cell Compatibility and Drug Delivery Studies
4	Novel Spectroscopic and Biophotonics Imaging Techniques for in-vivo and in-vitro Characterization

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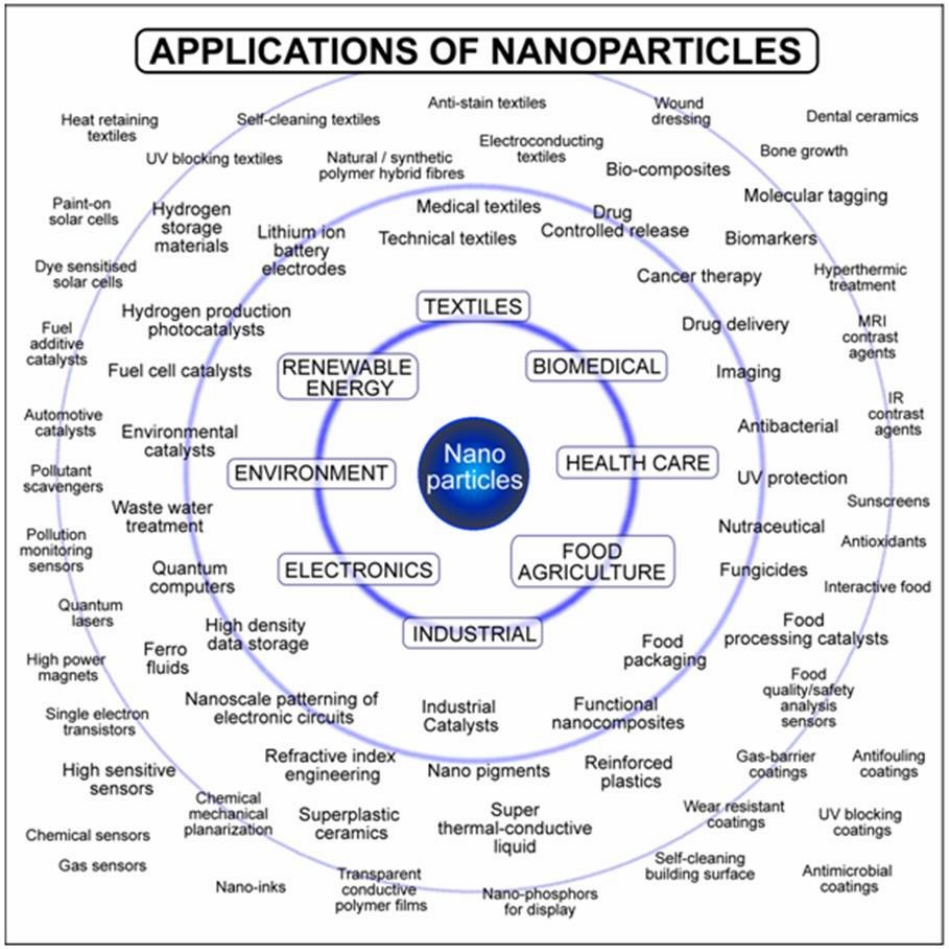
Potential TNA users

Main sectors of interest

- ✧ Industrial materials
- ✧ Food
- ✧ Cosmetics
- ✧ Insecticides / pesticides / fungicides
- ✧ Pharmaceuticals
- ✧ Medical devices
- ✧ Packaging
- ✧ Occupational safety and hygiene



TSUZUKI, T. 2009. Commercial scale production of inorganic nanoparticles. *International Journal of Nanotechnology,* 6, 567-578.

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TNA Proposals approved to date

2) NFFA ID 150 - Evaluation of cell internalization pathway, intracellular localization, genotoxic and immunotoxic effects of polymeric nanoparticles for targeted drug delivery

(Users: Simona Dimchevska & Nikola Geskovski, University SS Cyril and Methodius, North Macedonia)

The aim of this project is to reveal the self-assembled PLGA-PEG-PLGA and blended P(DLLA)CL/PEO-PPO-PEO ***drug loaded polymer (for targeted delivery to solid tumors) nanoparticle cellular uptake*** *alongside with the* ***genotoxic and immonotoxic profiles*** *in order to design a system with built in* ***safety and efficacy****.*

TNA Proposals approved to date

2) NFFA ID 298 - Characterisation of nanostructured luminescent textiles and their interaction with biological targets
(User: Ilaria Zanoni, University of Trieste & ISTEC-CNR, Italy)

*The present proposal will support **physicochemical characterization** requested for the development of luminescent textile coating based on **Ir complex encapsulated within SiO2 matrix nanophases (Ir@SiO2**). Our final goal is **to correlate physicochemical properties of designed coatings to their biological activity** both in terms of desired performances (self-markers nanophases, **antibacterial activity**) and of potentially **adverse effects for human health**.*

2 Publications:

NJC

PAPER

View Article Online
View Journal | View Issue

Cite this: *New J. Chem.*, 2018, 42, 9635

Encapsulation of cationic iridium(III) tetrazole complexes into a silica matrix: synthesis, characterization and optical properties†

Ilaria Zanoni,[a] Valentina Fiorini,[b] Marcos Rosado,[c] Belén Ballesteros,[c] Maria Androulidaki,[d] Magda Blosi,[a] Simona Ortelli,[a] Stefano Stagni,[b] Michele Dondi[a] and Anna Luisa Costa*[a]

Use of cotton textiles coated by Ir(III) tetrazole complexes within ceramic silica nanophases for photo-induced self-marker and antibacterial application

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[g] *Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, N. Plastira 100, 70013, Heraklion, Crete, Greece.*

TNA Proposals approved to date

3) NFFA ID 298 - Characterisation of nanostructured luminescent textiles and their interaction with biological targets
(User: Christina Isaxon, Nanosafety Lund, Sweden)

The main purpose od this project is to ***study different methods/systems of cell exposure*** *and to* ***characterize cellular stress responses and phenotypical/functional changes in the cell models induced by the nano material exposure****.*

Pending access to FORTH and SOLEIL …

Conclusions

- There is plenty of room for potential NFFA Users in the Nanosafety sector

- NFFA has aleady gained experience on providing TNA to nanosafety Users

- There is a clear need to identify and harmonize common nanosafety protocols and practices as well as to define guidelines within the NFFA. The **NFFA nanosafety project** is the tool to set this basis.

Nanosafety is there !

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Thank you

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