INSTITUTE FOR NANOSTRUTURES, NANOMODELLING AND NANOFABRICATION

Since its creation in 2006, i3N has established itself as a leading national and international institute, in the area of advanced materials and nanotechnologies. Pioneering fields such as photovoltaics, thin-film microelectronics, and transparent electronics. With an interdisciplinary structure, i3N comprises six research groups addressing strategic challenges, including sustainable nanotechnology and biomedical engineering. I am proud to highlight the eleven ERC grants already achieved, reinforcing our leadership in Materials Science and Nanotechnology in Portugal.

At i3N, we believe that the collective strength of a collaborative team far exceeds the sum of its parts, particularly in a multidisciplinary field like Nanotechnology. Beyond advancing research, we are also training the next generation for academia, industry, and entrepreneurship. With state-of-the-art tools available at i3N, the sky is no more the limit!



CONTENTS

ABOUT i3N 3

MISSION & GOALS 4
- i3N governance 6
- Organizational structure 7
- Thematic lines 8

RESEARCH AREAS & SCIENTIFIC OUTPUTS 10

FACTS & FIGURES 12
- Research highlights 12
- People 14

RESEARCH FACILITIES 16
- Material/Device fabrication 16
- Material device/characterisation 18

FUNDING 20
- ERC 21
- FCT 22
- REPowerEU-PRR 23
- European Comission 24
- Industry 27

SCIENCE & SOCIETY 28

KNOWLEDGE TRANSFER & INNOVATION 30

i3N

ABOUT US

— Created in 2006 an a **Associate Laboratory** by the Portuguese Minister of Science, Technology and Higher Education

We all share the same vision, a more sustainable future.
i3N will be a key player in achieving this goal, in the area of advanced materials and nanotechnologies.



i3N is a partnership between 2 leading research units in fundamental and applied science: CENIMAT (NOVA University of Lisbon) and FSCOSD (University of Aveiro).



i3N

MISSION & GOALS

01 VISION

With the state-of-the-art tools for micro/nanotechnology fabrication, advanced materials production, and device characterization available at i3N, the sky is no more the limit in terms of what one can achieve here!

02 CAMPI

04 THEMATIC LINES

06 RESEARCH GROUPS

MISSION

i3N conducts research in the strongly multidisciplinary field of advanced materials, nanotechnology and nanosciences.

The mission of i3N is:

- Promoting scientific excellence and innovation in Sustainable Functional Advanced Materials, using green technologies, to serve a plethora of fields and for socio-economical ends, aligned with the Sustainable Development Objectives and the Green Deal.
- Pushing the international leading edge of research by fostering breakthrough concepts and exploiting materials and device properties at nanoscale level.
- Promoting practical applications of R&D+I results, including their transfer to the industry.
- To provide access of the institute facilities and equipment to the technical-scientific community and lending assistance to industry.
- Training and enabling the continuous education of scientific personnel (including MSc and PhD students) and technical researchers, enabling them to overcome the future challenges of science and technology cross cutting fields.
- Fostering public awareness, engagement and understanding of advanced materials, nanoscale science, engineering and nanotechnology.
- Providing scientific and technical evidences in order to sustain the Public Policies for the changes of the future.

i3N has defined the following key performance indicators for achieving its mission:

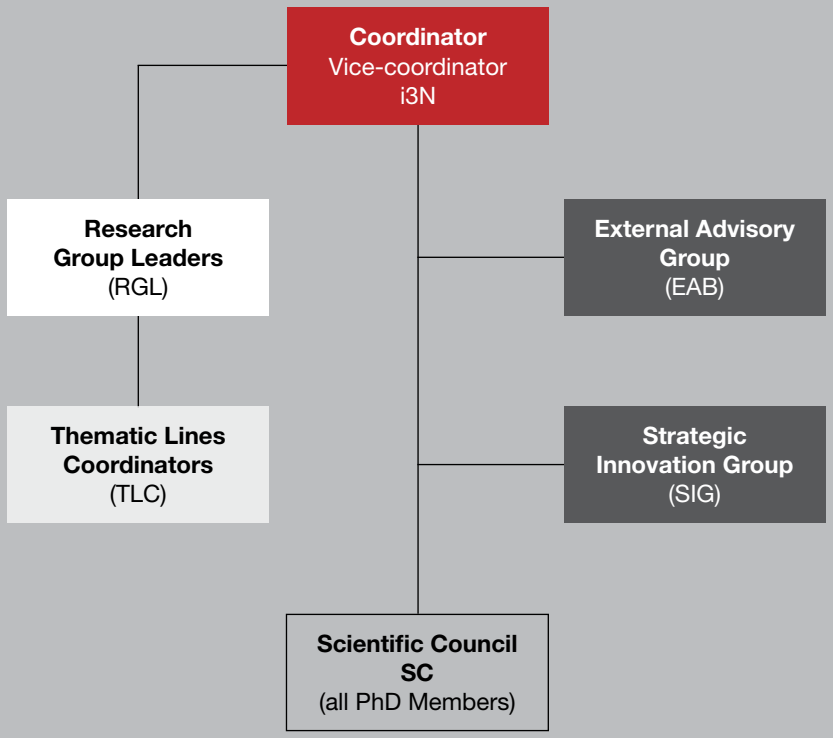
- Scientific publications in highly ranked journals.
- Balance between national and external funding, specially through European Projects and Contracts with industry.

GOALS

i3N focuses on three main issues to pursue its mission:

- To create a top environment for international scientific talent.
- To create strong multidisciplinary cohesion within the infrastructure.
- To be a national leader and international key player in nanotechnology and advanced materials.

i3N GOVERNANCE



06

RESEARCH GROUPS

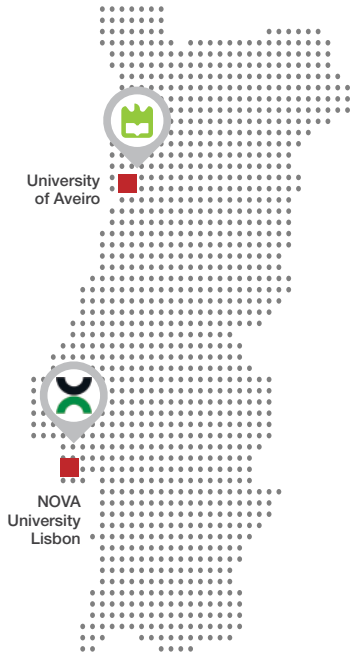
- **RG1** Materials for Electronics, Optoelectronics and Nanotechnologies
- **RG2** Nanophotonics and Optoelectronics
- **RG3** Physics of Advanced Materials and Devices
- **RG4** Soft and Biofunctional Materials
- **RG5** Structural Materials
- **RG6** Theoretical and Computational Physics

04

THEMATIC LINES COORDINATIONS

- **TL1** Sustainable Micro and Nanofabrication
- **TL2** Green and Clean Energy Systems
- **TL3** Nanomaterials Engineering and Functional Interfaces
- **TL4** Biomedical Devices and System

ORGANIZATIONAL STRUCTURE



University of Aveiro Hub



José Fernando Mendes
Vice-Coordinator
RG6 Research Group Leader
Theoretical and Computational Physics Group



Florinda Costa
TL3 Thematic Line Coordinator
Nanomaterials Engineering and Functional Interfaces



João Veloso
TL4 Thematic Line Coordinator
Biomedical Devices and Systems



Paulo Antunes
RG2 Research Group Leader
Nanophotonics and Optoelectronics



Manuel Graça
RG3 Research Group Leader
Physics of Advanced Materials and Devices

NOVA University of Lisbon Hub



Rodrigo Martins
Coordinator
TL2 Thematic Line Coordinator
Green and Clean Energy Systems



Pedro Barquinha
TL1 Thematic Line Coordinator
Sustainable Micro and Nanofabrication
RG1 Research Group Leader
Materials for Electronics, Optoelectronics and Nanotechnologies



João Paulo Borges
RG4 Research Group Leader
Soft and Biofunctional Materials

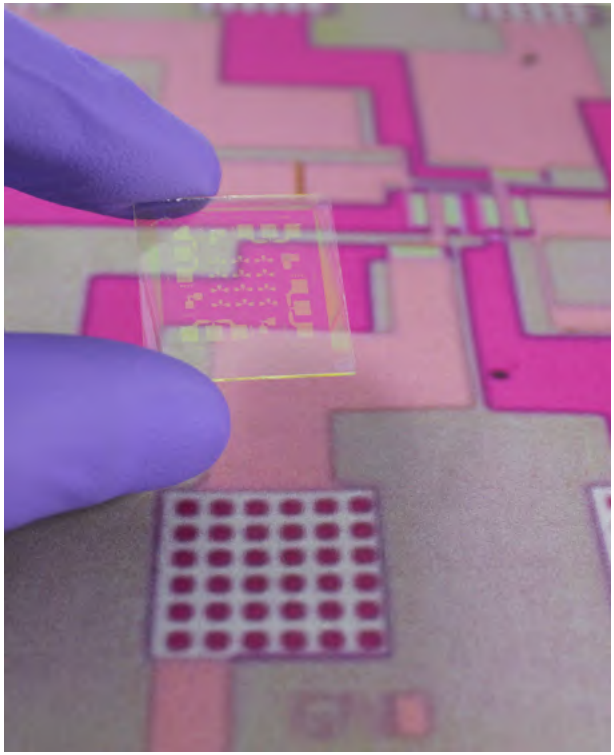


João Pedro Oliveira
RG5 Research Group Leader
Structural Materials

RESEARCH THEMATIC LINES

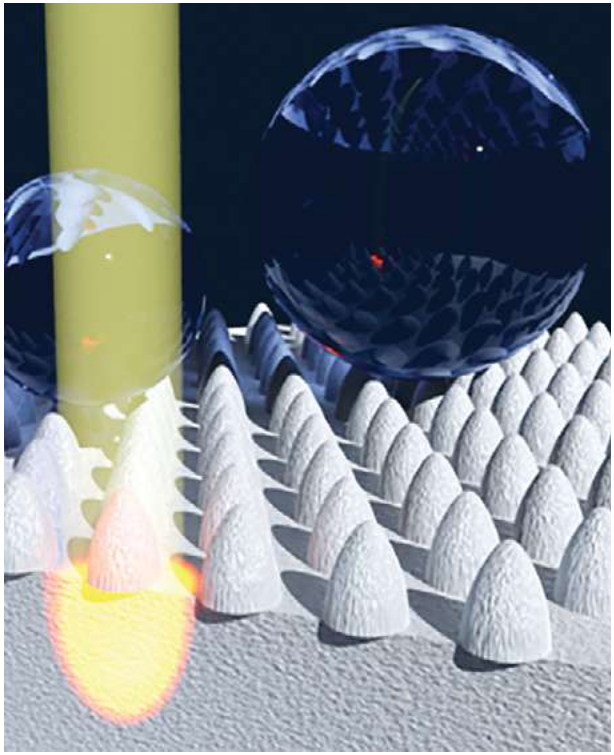
TL1
SUSTAINABLE MICRO AND NANOFABRICATION

Since 2003, i3N has been a leader in oxide thin-film transistors (TFTs). While materials like indium-gallium-zinc oxide (IGZO) are explored industrially, i3N pursues breakthrough advances, on more sustainable semiconductors.



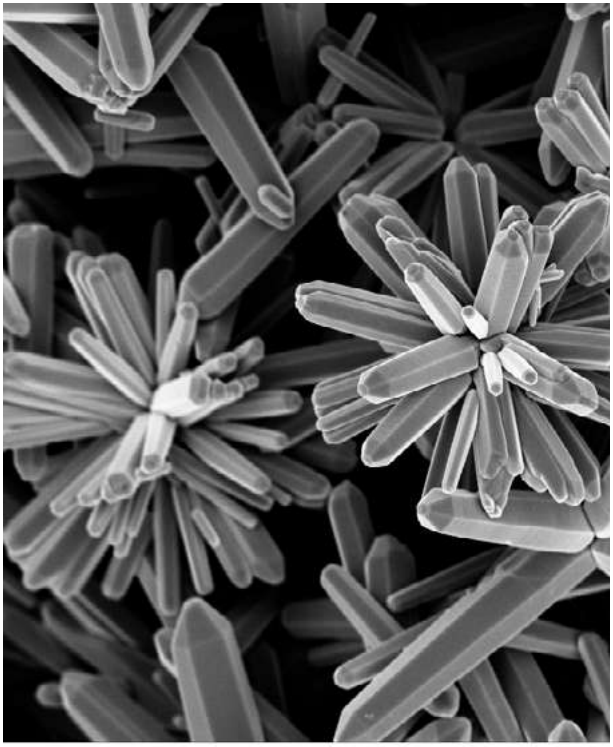
TL2
GREEN AND CLEAN ENERGY SYSTEMS

We focus on consumer-oriented renewable power systems exploring cost-effective energy harvesting (e.g. photovoltaics improved with photonics, mechanical from motion, thermal) and storage (e.g. batteries and supercapacitors, solar fuels) aiming for a fully decarbonized society.



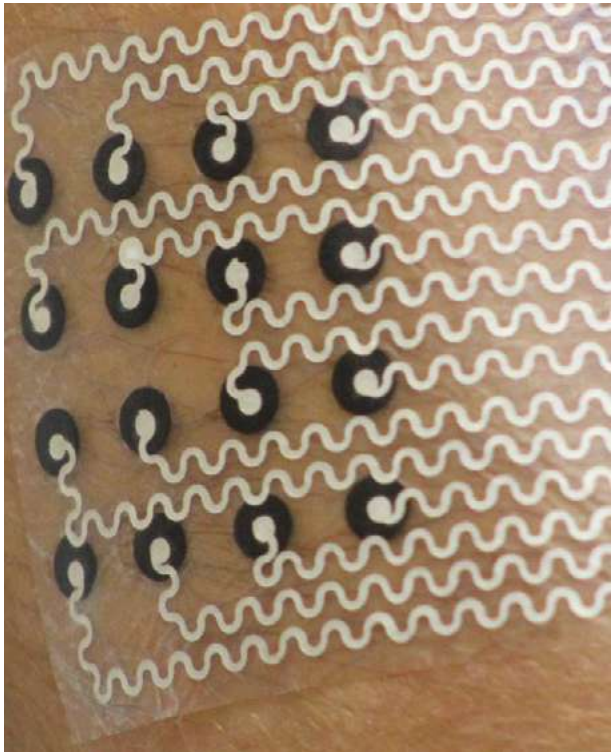
TL3
NANOMATERIALS ENGINEERING AND FUNCTIONAL INTERFACES

Our emphasis is on developing materials and nanoparticles for energy, optoelectronic, electronic, and bio applications. We also functionalize interfaces for diverse applications.



TL4
BIOMEDICAL DEVICES AND SYSTEMS

We work on innovative biomedical solutions for disease prevention and precision medicine, developing medical devices, imaging systems, and regenerative medicine to improve longevity.





i3N

RESEARCH AREAS & SCIENTIFIC OUTPUTS

+18%

SCIENTIFIC PUBLICATIONS *

MAIN SCIENTIFIC AREAS

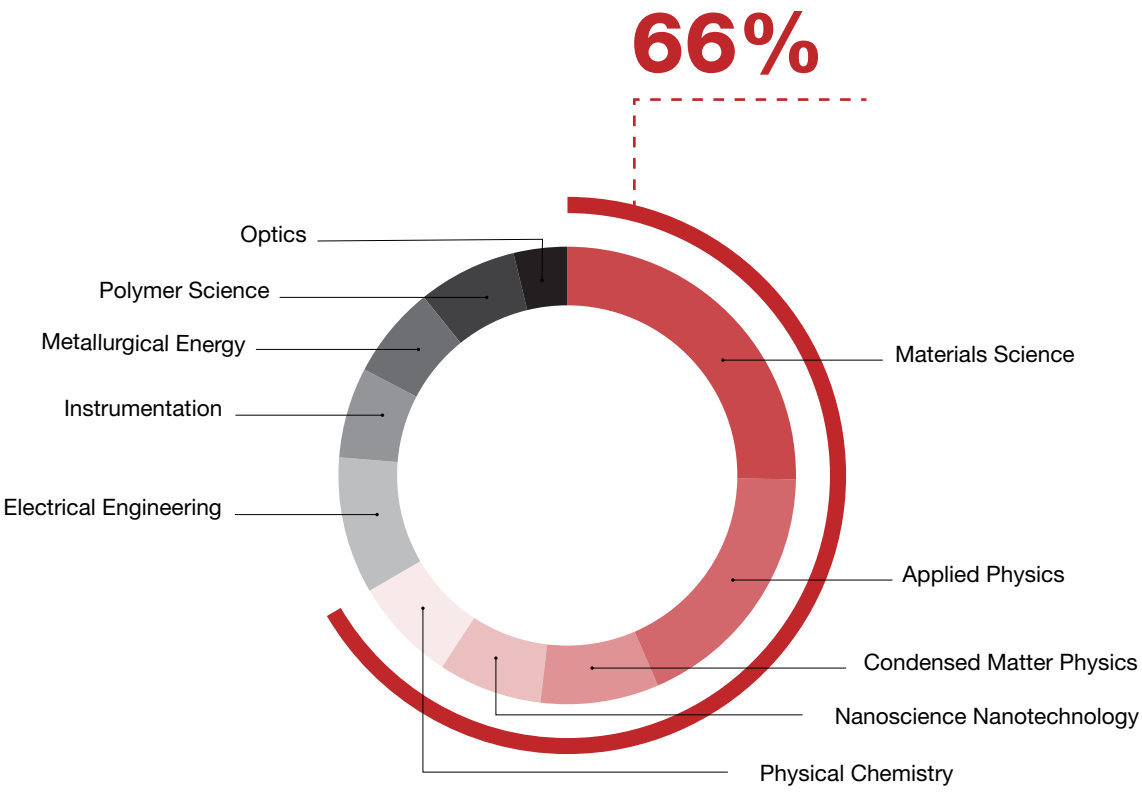
- Materials Science
- Applied Physics
- Condensed Matter Physics
- Nanoscience Nanotechnology
- Physical Chemistry

* Over the previous five-year period

MAIN SCIENTIFIC AREAS OF PUBLICATION

+70%
HIGH-RANKING JOURNALS

63%
INTERNATIONAL COLLABORATION





i3N

FACTS & FIGURES

_ research highlights

(2018 — 2023)

SCIENTIFIC PUBLICATIONS
+ 18% growth

CITATIONS
+ 50% growth

i3N H-INDEX
+ 56% growth

PROJECTS GRANTED
+ 20% growth

(percentage growth over the previous five-year period)

SCIENTIFIC INDICATORS

SCIENTIFIC PUBLICATIONS
+1600

HIGHLY CITED PAPERS
42

PATENTS ISSUED
58

HIGH-RANKING JOURNALS
70%

INTERNATIONAL COLLABORATION
63%

CITATIONS
+60000

i3N H-INDEX
111

CONFERENCE ORGANIZATION
+30

PLENARY / KEYNOTE
78

INVITED
170

COMMUNICATIONS
+1400

PROJECTS GRANTED

+61 M€

45
DEMONSTRATORS/ PROTOTYPES DEVELOPED

07
ERC
2018 — 2023

102
PROJECTS

i3N

FACTS & FIGURES

_ people

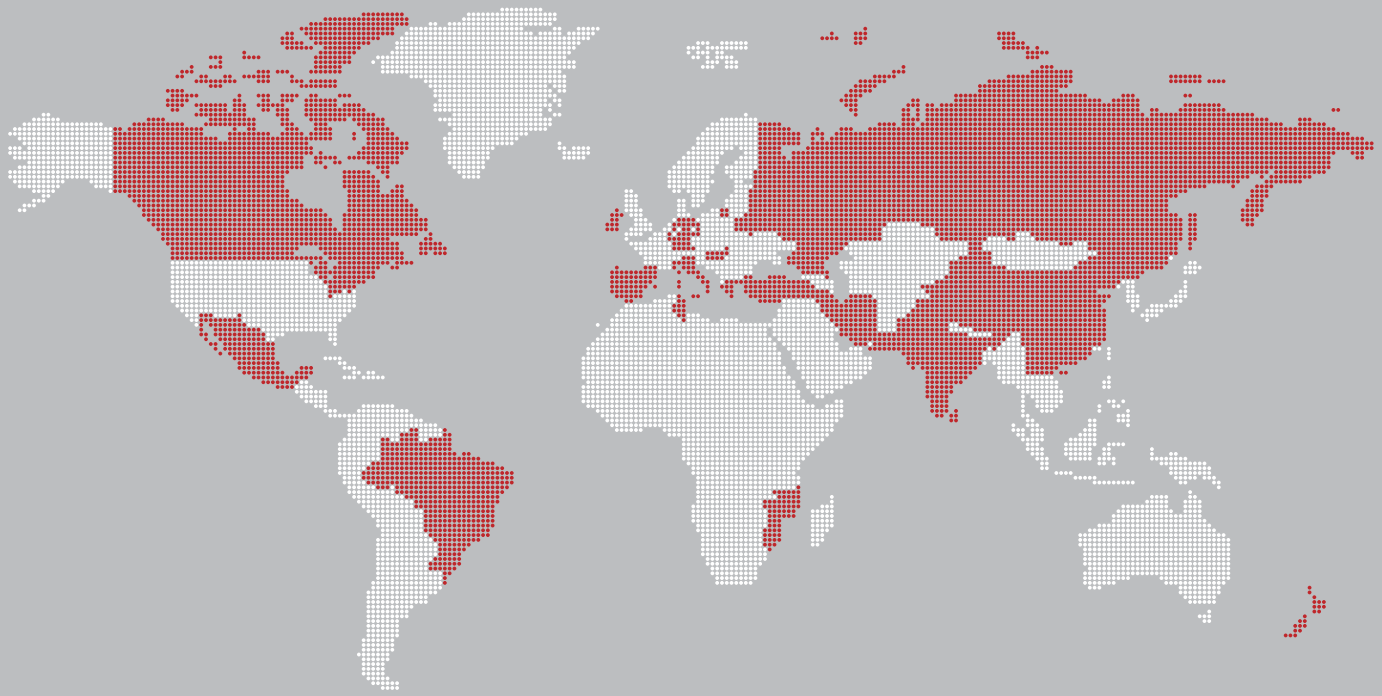
(2018 — 2023)

+22

NATIONALITIES

20%

i3N INTERNATIONAL MEMBERS



i3N COMMUNITY



TOTAL MEMBERS
256

FEMALE
+35%

ACADEMIC STAFF	58
RESEARCHERS & POSTDOCS	67
PhD STUDENTS	56
COLLABORATORS	63
TECHNICIANS/ADMINISTRATIVES	12

PRIZES & AWARDS

75

NATIONAL AND INTERNATIONAL PRIZES & DISTINCTIONS

EDUCATIONAL INDICATORS

Advanced training of the future generations

Marie Curie Fellowships (3)
Marie Curie Networks (2)
ERASMUS programmes (2)
Cost Actions (3)

+460 MSc

+60 PhD

25 DOUBLE DEGREE

07

DOCTORAL PROGRAMS

Materials Engineering
Nanoscience and Nanotechnologies (2)
Advanced Materials and Processing
Physics Engineering
Physics
Biomedical Engineering

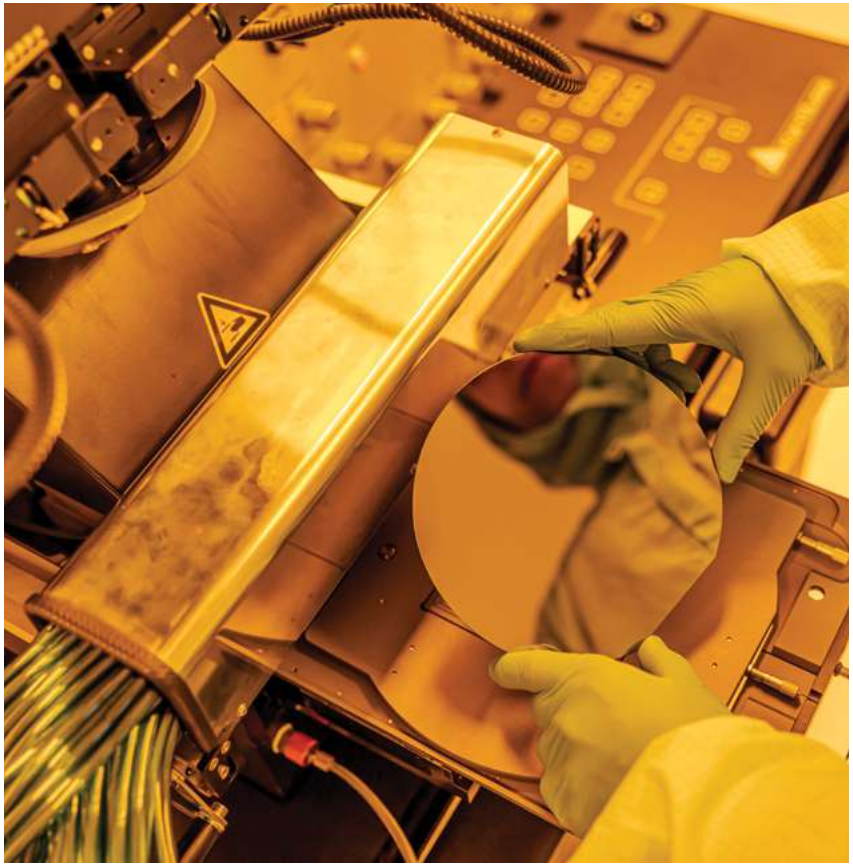
i3N

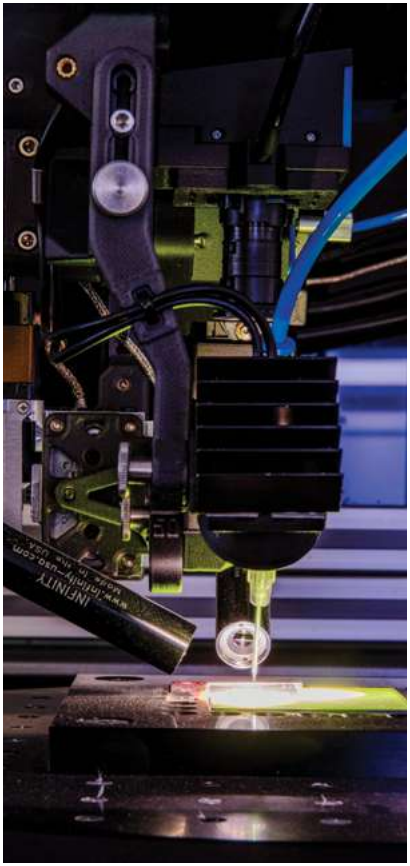
RESEARCH FACILITIES

_ material device/ fabrication

i3N Microelectronics Laboratories are state-of-the-art thin film based semiconductor research and fabrication facilities that support the design, fabrication, and testing of novel devices and systems.







03

CLEAN ROOM FACILITES WITH 1080 m²





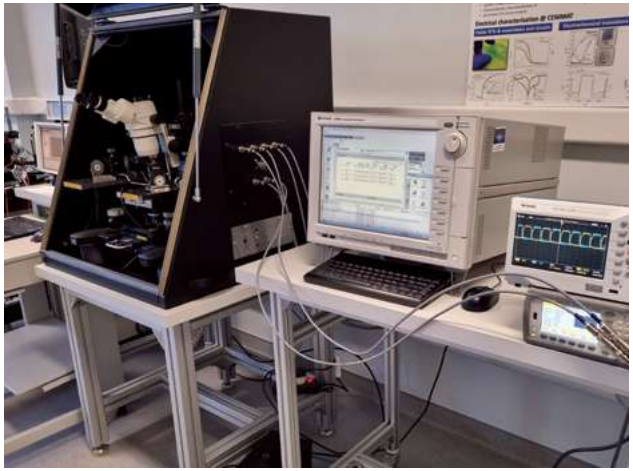
i3N

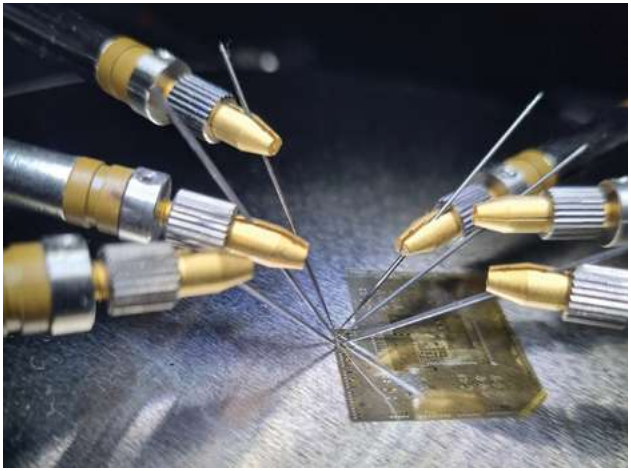
RESEARCH FACILITIES

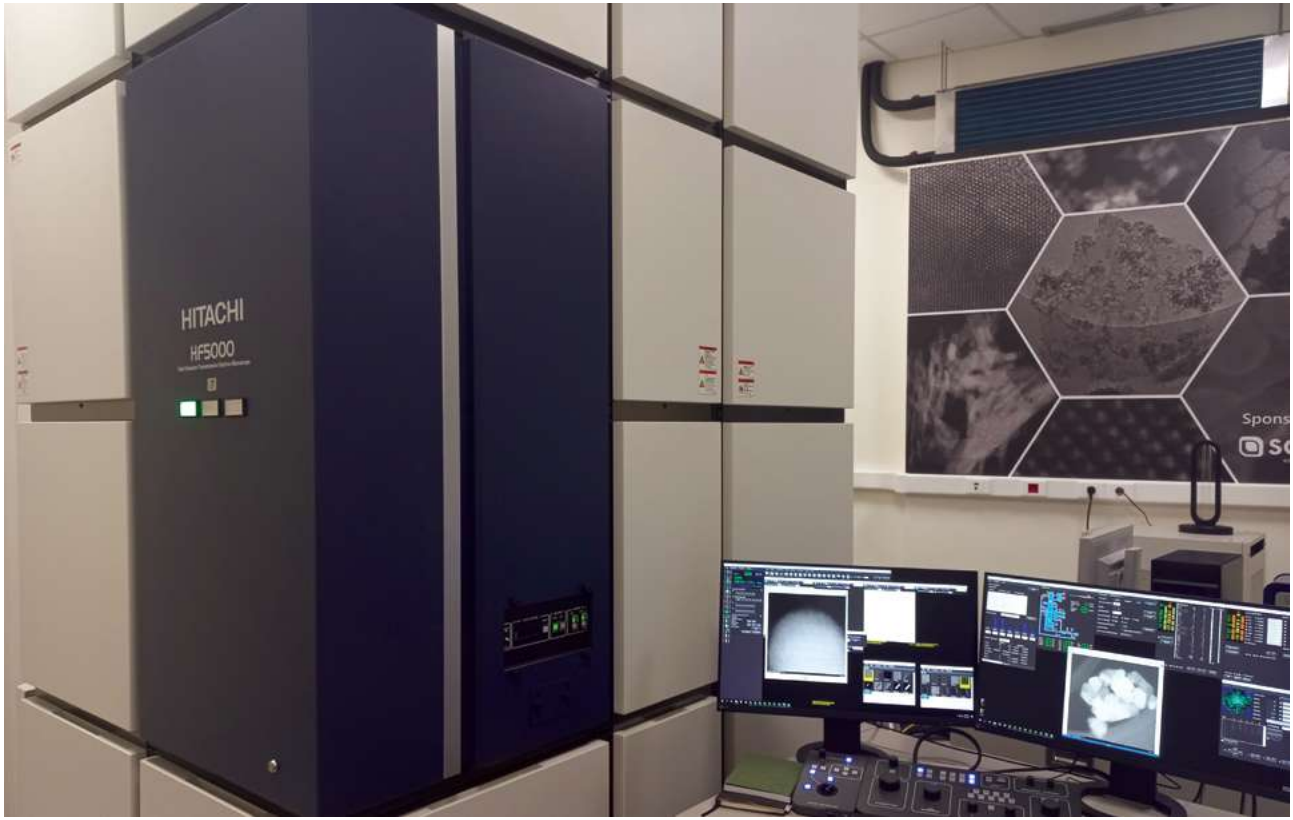
_ material device/ characterisation

A state-of-the-art infrastructure that provides access to advanced equipments, ranging from design to fabrication and characterisation:

— Advanced Electron Microscopy
— Micro and Nanofabrication
— Nanophotonics & Bioimaging
— Materials Characterisation





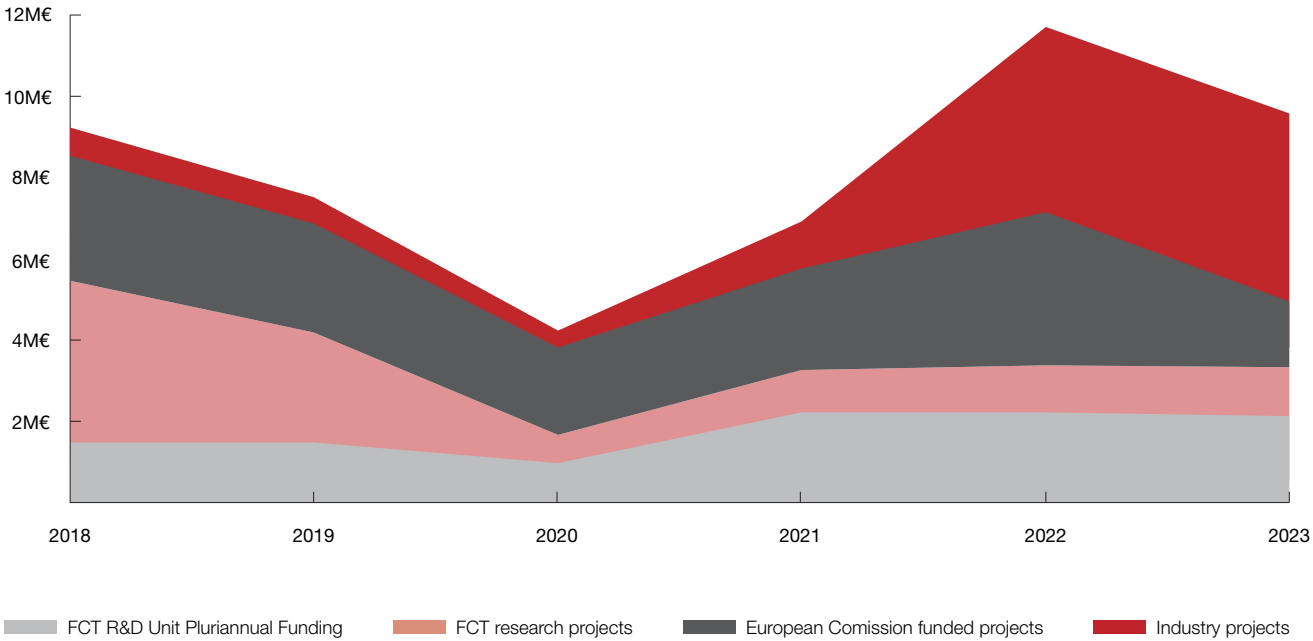

HITACHI
HF5000

i3N

FUNDING

PROJECTS

Finantial sustainability: to achieve scientific, industrial, and societal challenges, i3N is involved in numerous research projects, some of them co-funded by FCT.



GRANTS

ERC
European Research Council

13.4 M€
11 ERC PROJECTS



Our commitment to scientific excellence and innovation is demonstrated through the largest number of ERC grants in the area of materials and nanotechnology in Portugal.

ADVANCED FUNCTIONAL MATERIALS

AdG ERC, INVISIBLE
Grant nº 228144 | (2009-2014)
2.25 M€

AdG ERC, DIGISMART
Grant nº 787410 | (2019-2023)
3.5 M€

ERC PoC, e-GREEN
(2022-2023)
150 k€

StG ERC, NewFun
Grant nº 640598 | (2015-2020)
1.4 M€

MATERIALS FOR ENERGY

StG ERC, TREND
Grant nº 716510
(2017-2021)
1.5 M€

ERC PoC, FLETRAD
(2022-2024)
150 k€

ERC PoC, EXCELL
(2023-2024)
150 k€

CoG ERC CapTherPV
Grant nº 647596 | (2015-2020)
2 M€

ERC PoC CAPSEL
(2018-2019)
150 k€

ERC PoC, INSOLENSYS
(2021-2022)
150 k€

CoG ERC, XSTREAM,
Grant nº 101124803
(2024-2029)
2 M€

PROJECTS

FCT

22 M€

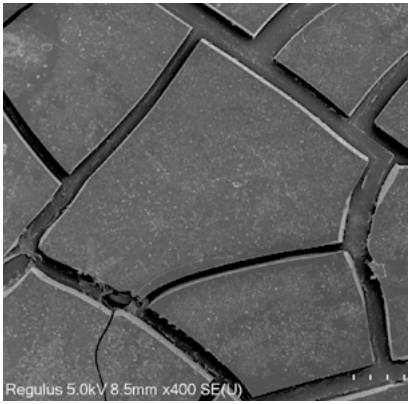
FCT UNIT FCT PROJECTS

Fundação para a Ciência e a Tecnologia

Pluriannual funding is fundamental to guarantee the operational and scientific structure of i3N. Our researchers multiply its budget by 6 through other competitive project calls, including FCT R&D Projects.

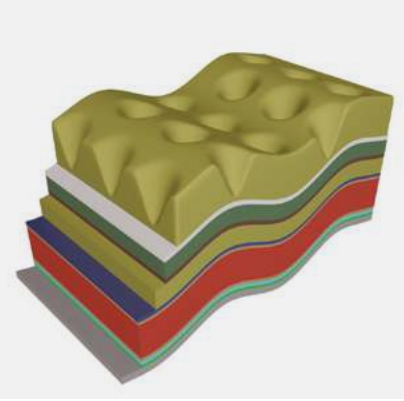
DynaCellCollect

DynaCellCollect aims to develop hygromorphic cellulose-based membranes to efficiently capture water from air using micro/nano helical filaments responsive to humidity. These flexible, porous membranes promote water flow via gravity and reset for continuous collection. Inspired by spiderwebs and desert beetles, they require no electronics or complex machinery, suitable for drought-prone regions and greenhouses.



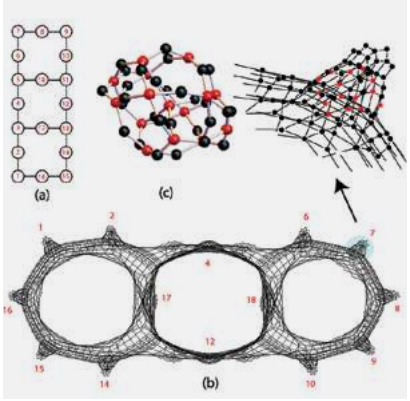
SpaceFlex

SpaceFlex will launch a new trend in PV technology, endowed with high efficiency plus flexibility and fabricated with inexpensive materials, and will demonstrate it for Space-qualified powering with unprecedented power/weight and power/cost ratio. To achieve this, we will drive disruptive advances in thin multi-junction solar cells enhanced with light management, capitalizing on the pioneering R&D of CENIMAT and LusoSpace.



QUANTDYN

This project explores protected quantum states, focusing on two key areas: i) many-body electronic states in topologically non-trivial 1D systems, and ii) frustrated Hamiltonians allowing particle separation. We study their time evolution, interactions with the environment, and transport measurements in these systems.

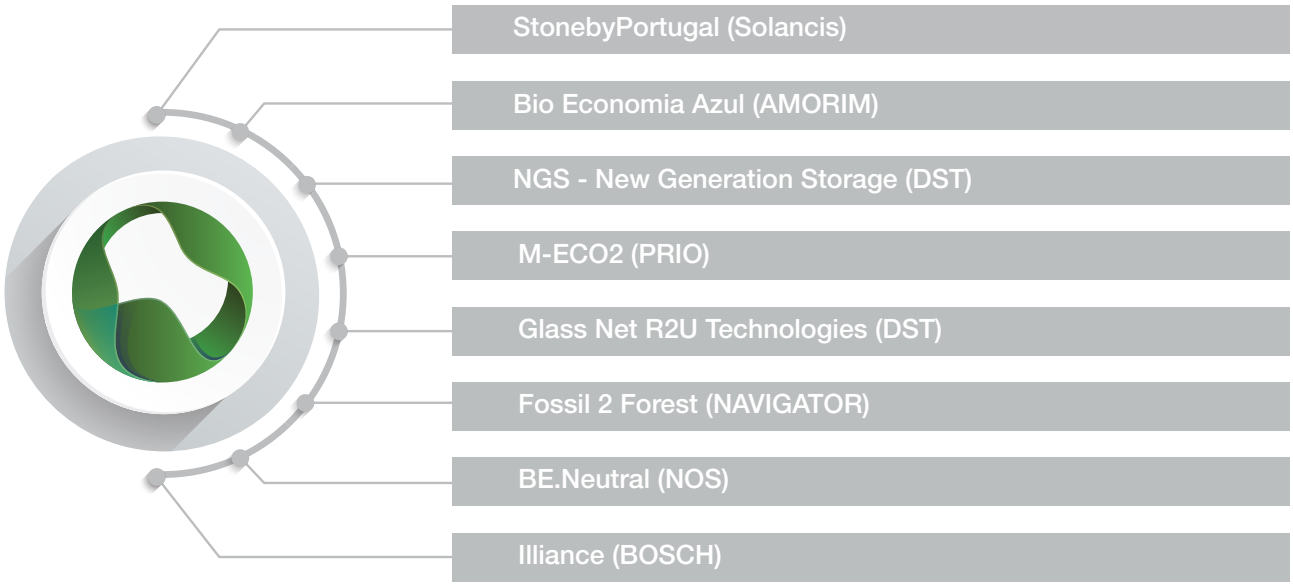


PROJECTS

REPowerEU-PRR

16 M€
PRR FUNDING

The success of i3N's participation in 8 Mobilizing Agendas within the scope of the Resilience and Recovery Plan, clearly demonstrates the decisive role that i3N has in the Portuguese economy, thus contributing to the leveraging of several technologies with special emphasis in the areas of green energy and sustainable functional materials.



PROJECTS

EUROPEAN COMISSION
Projects in the area of CHIPS ACT and Emerging Technologies

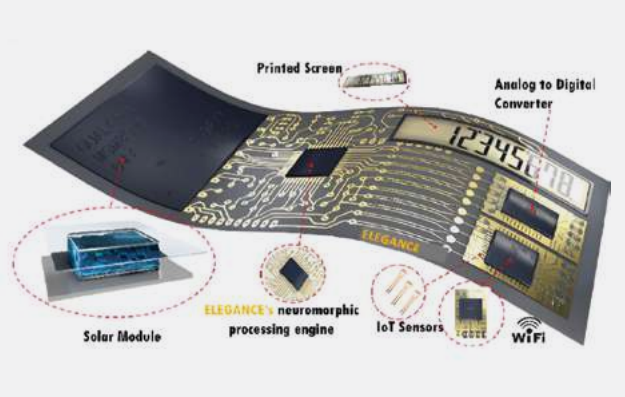
16 M€

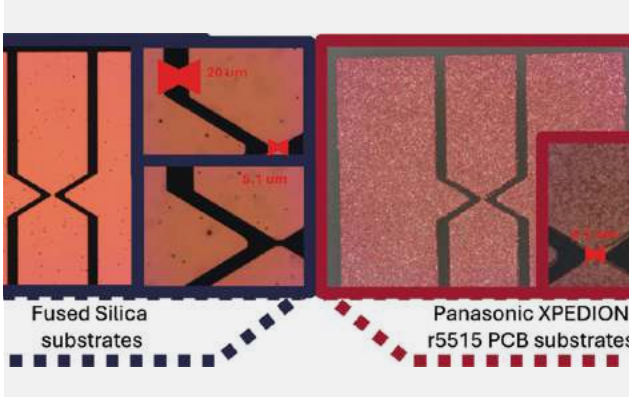
ELEGANCE

It proposes the development of a radically new, printable and light-operated processing technology specialized for IoT edge-computing applications. The project implements an eco-sustainable approach at component and processes level, where abundant, recyclable eco-friendly materials are employed, targeting a zero environmental footprint strategy.

TERRAMETA

The TERRAMETA project explores cutting-edge 6G technologies, focusing on Terahertz (THz) Reconfigurable Intelligent Surfaces (RIS) for ultra-high data rate wireless networks. It will develop THz RIS and transmitter/receiver hardware, including innovative memristor RF switches for the D-band, to optimize network performance. Real-world testing in indoor, outdoor, and factory settings will demonstrate 6G applications, driving major innovations in 6G systems.





i3N has a wide international network tackling all the value chain within sustainable nanotechnologies and advanced materials, being collaborative research and innovation actions pillars to our activity.

SUPERIOT

SUPERIOT is a Horizon Europe project which aims to develop a truly sustainable and highly flexible internet of things (IoT) system based on the dual-mode use of optical and radio communications, implemented using printed electronics technology.

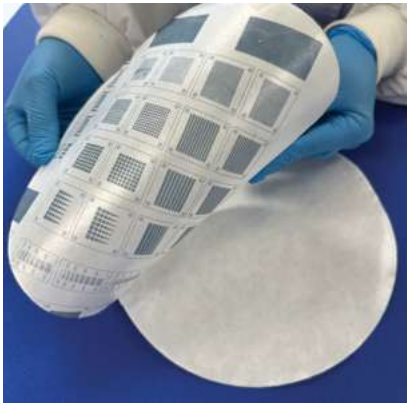
REFORM

The REFORM project advances sustainable, flexible, and printed electronics by developing innovative materials like cellulose-based substrates, organic conductive inks, and bio-based adhesives. It aims to improve circularity and recycling in electronics, focusing on scalable prototypes for green sensors and technologies, with a strong emphasis on sustainability and climate-neutral solutions across industries.

SURE2COAT

SURE2COAT, is a Horizon EU project, that aims the development and integration of sustainable surface treatments for complex shape components for transsectorial industrial innovation. I3N goal is the use of laser surface treatment on copper fins to improve heat transfer and reduce corrosion in gas water heaters produced by BOSCH







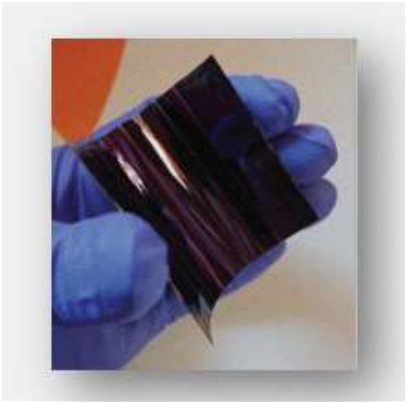
PROJECTS

EUROPEAN COMISSION

Projects in the area of CHIPS ACT and Emerging Technologies

JUMP INTO SPACE

JUMP INTO SPACE research project objectives is to develop all-perovskite tandem solar cells, assessing its sustainability, by developing and tuning innovative materials and multipurpose photonic substrates. Flexible solar cells and modules will be manufactured for in-space energy harvesting and effectively encapsulated to withstand operation in space harsh conditions.



INFRACHIP

INFRACHIP is a European research platform focused on developing next-generation semiconductor chips. It provides free access to cutting-edge technologies across Europe, supporting the EU's digital and green transitions. INFRACHIP enhances research, addresses barriers, and boosts skills in semiconductor innovation from early to medium readiness levels.



INSTABAT

The INSTABAT project integrated into the BATTERY 2030+ research initiative and focused on developing new methodologies to sense critical parameters, towards smart batteries. i3N customized optical fiber sensors to integrate into lithium-ion battery cells to reliably perform in operando monitoring of key parameters, such as temperature, pressure, and state of charge.



PROJECTS

INDUSTRY
PT2020 e ANI

7 M€
INDUSTRY FUNDING

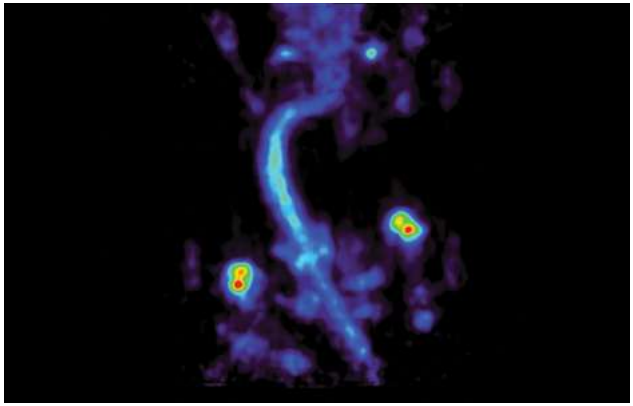
i3N has been expanding the access to its world-class infrastructure and knowledge to support scientific and industrial communities advancing their research and solving production challenges.

BrainPet

This project aims to test and validate the potential of an innovative PET system for brain molecular imaging, based on easyPET technology, which has already produced a high-resolution, compact, and cost-effective preclinical PET system. It enables early detection of metabolic anomalies, aiding in diagnosing Alzheimer's and brain tumors.

SafeHome

SAFE-HOME is a multidisciplinary project combining sensor design, AI, machine learning, and wireless networking to monitor elderly activity in confined spaces. It aims to detect emergencies and alert relevant personnel. The University of Aveiro team focuses on fiber-optic sensors to measure vertical pressures and track movement.





i3N

SCIENCE & SOCIETY



PUBLIC AWARENESS

Fostering public awareness, engagement and understanding of advanced materials.

55 ACTIONS

~18000 STUDENTS

Ciência Viva







European Researchers' Night



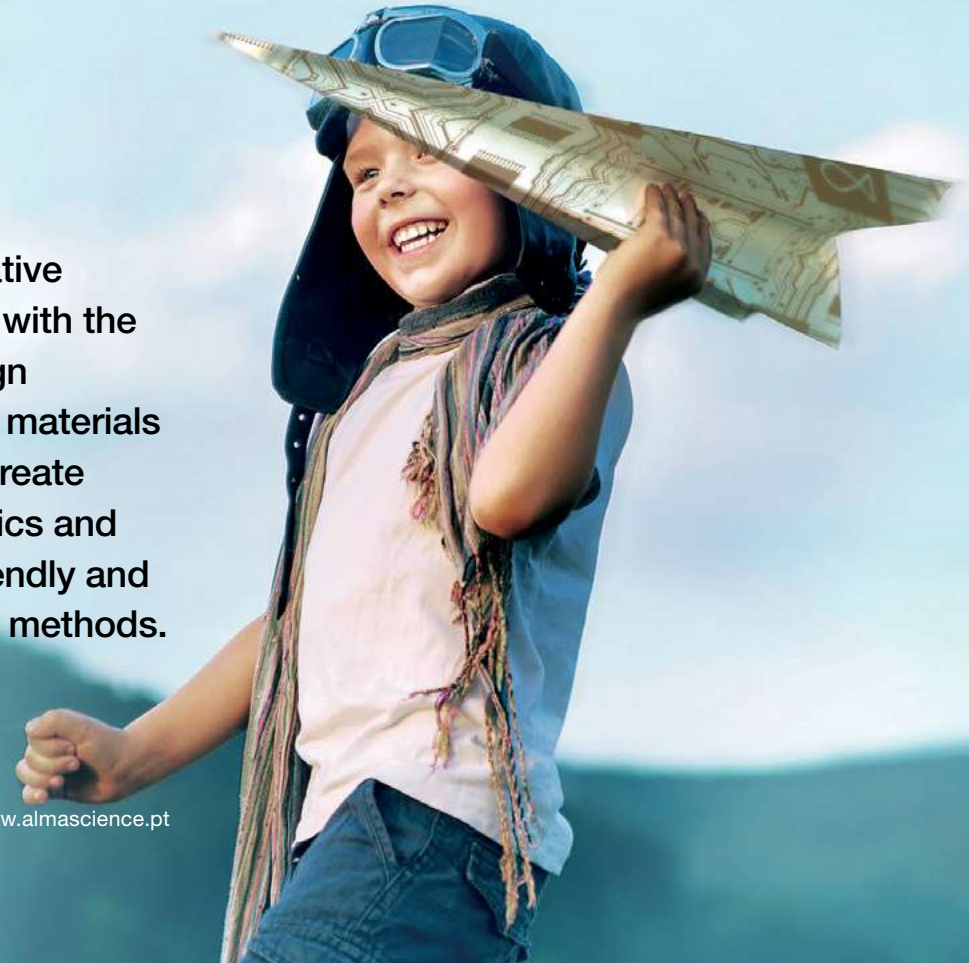




Summer Schools

i3N

KNOWLEDGE TRANSFER & INNOVATION



AlmaScience is a collaborative laboratory born inside i3N, with the mission to foster eco-design strategies with sustainable materials (paper, cork, cellulose) to create high-performance electronics and technologies using eco-friendly and ultra-low waste production methods.

alma science

www.almascience.pt

RI.TE Spin Off

www.ri-te.pt

Positron Emission Tomography (PET) is a wonderful molecular imaging technology, instrumental to tackle cancer and other diseases. RI-TE is a spin-off from i3N developing uniquely compact and affordable high-resolution PET systems with reduced complexity, weight and costs by more than 5 times, enabling a more flexible and broader use of this powerful technology.



NU-RISE Spin off

www.nu-rise.com

NU-RISE is a spinoff of I3N that has developed an innovative solution for radiotherapy, enabling real-time monitoring of radiation delivery, making treatments safer and more precise while reducing the number of sessions required. By collecting data on radiation levels around the tumor as well as in healthy tissues and organs at risk of overdosing, This enables treatment with greater efficiency and precision, while also protecting patients from unnecessary radiation, reducing the risk of severe side effects or the need for additional treatments. It marks an evolution in radiotherapy — cancer treatments that are faster, more personalized, and safer.



This work is funded by National Funds through the FCT - Fundação para a Ciência e a Tecnologia, I.P., and the Ministério da Educação, Ciência e Inovação under the scope of the projects LA/P/0037/2020, UIDB/50025/2020 and UIDP/50025/2020

i3N wet labs, has received in 2024 the certification from “My Green Lab Certification”, as a commitment to Sustainable Science! My Green Lab Certification is considered the gold standard for laboratory sustainability best practices around the world and was recognized by the United Nations Race to Zero campaign as a key measure of progress towards a zero-carbon future.