

CATALONIA BEST PRACTICE

BIOCIDE²LIFE

Micro- and Nano-encapsulated Biocides: the next generation of
Disinfectants with Short + Long-²Life Antimicrobial Activity

Spain Annual Event

European Regional Development Fund

26th January 2016

1. Summary

- 1) The Institute: Catalan Institute of Nanoscience and Nanotechnology (ICN2)**
- 2) The Group: Supramolecular NanoChemistry & Materials (NANO^{UP})**
- 3) The Project: BIOCIDE²LIFE**

1.1. ICN2: Contextual Background



Institut Català
de Nanociència
i Nanotecnologia



- CERCA centres: Non-profit foundations created by the Catalan Government since early 2000's to promote R&D excellence.
- Linked to ICREA programme to attract talent: 240 professorships (41% in CERCA institutes; 239 of 2940 applicants selected; 48% foreign nationality; 62% recruited from abroad).



- Largest public Science institution in Spain; 3rd largest in Europe.
- Basic and Applied R&D; Technology Transfer; Sci/Tech Consulting; Training; Dissemination of Scientific Culture, etc.
- Physical, Natural, Life and Social Sciences; Humanities; and Food/Agriculture.
- In Spain: 6% of all R&D personnel → 20% of all scientific production
- Major research infrastructure: laboratories, technical facilities, libraries, databases and public repositories.

1.1. ICN2: Contextual Background

Mission:

To become an international centre of reference in Nanoscience and Nanotechnology.

Core activities:

- Frontier Basic and Applied Research in N&N
- Technology Transfer
- Public Outreach

Role in Society:

To facilitate the adoption and integration of nanotechnologies in Catalan society and industry.



1.1. ICN2:

Some numbers *(as April 2014)*

Annual Budget: ~ €10 million

Sources: Patrons & Public Agencies: 43%, Competitive Funding: 52%, Companies: 5%

Total staff: ~ 200

Demographics: 44% female, 70% are 35 or younger

Researchers: 170 (130 staff + 40 visiting)

Professorships: 8 ICREA Research Profs and 3 CSIC Research Profs

Fellowships: 6 ERC-SG (3 current + 3 past), 1 Marie Curie, 4 RyC and 2 JdIC

Organisation: 15 Research Groups and 4 Technical Divisions

Scientific Output: ~ 170 indexed publications annually

ICN2 awarded Severo Ochoa Centre of Excellence, only 18 in all Spain;

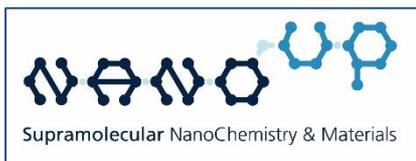
ICN2 is in the top-ten of all Spanish R&D centres in all measures of excellence

(ICONO Scimago Report 2013)

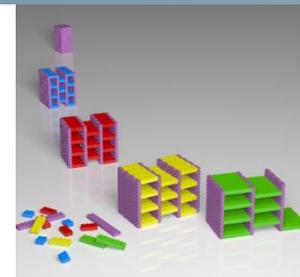
Total laboratory space: ~ 2,000 m²

Key facilities: electron microscopes (SEM, S/TEM, TEM), R2R NIL; FIB; XPS;
Nanomoke, wet chemistry labs, access to clean rooms (CNM, UAB, ICMA B)

1.2. NANO^{UP}: Group Information

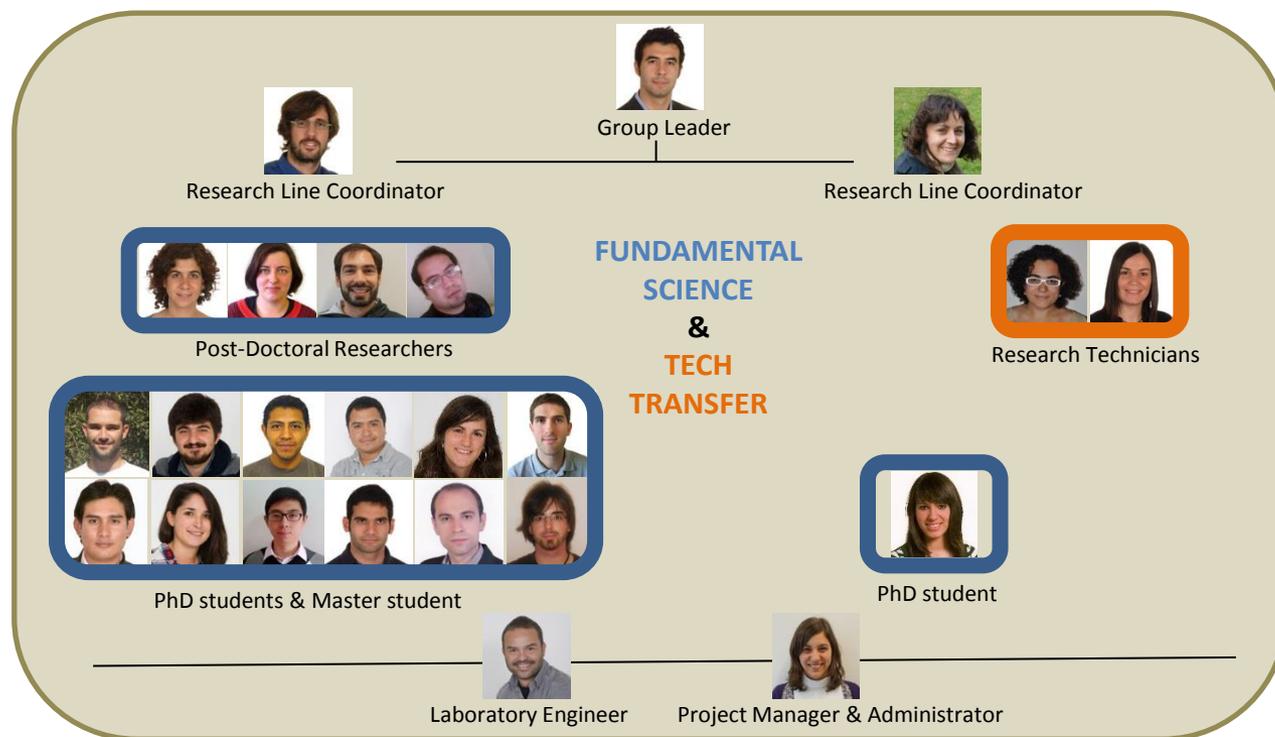


*“Controlling the **supramolecular assembly** of (bio)molecules, metal ions and nanoscale building blocks **at the nano-meter scale** for the design and synthesis of **novel functional MOFs and carriers**”*



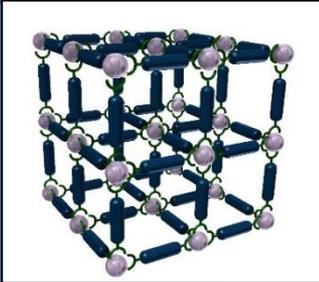
Personnel (24 members):

- 1 ICREA Professor
- 1 RyC Researcher
- 1 Senior Researcher
- 6 Postdoctoral researchers
- 1 Laboratory Engineer
- 1 Project Manager
- 11 PhD Students
- 1 PhD Visiting Student
- 1 Master Student



1.2. NANO^{UP}: Research Lines

Fundamental
Science



Metal-Organic Frameworks (MOFs)

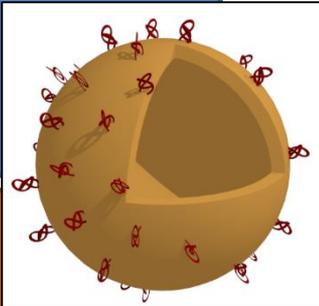
(Since 2011)

- Making MOFs by linker design
 - Biomolecules
 - Contrast agents
 - Sorption/catalytic enhancers
- Nanoscale MOFs/MOF nanoparticles
- MOF-based composites & superstructures
- MOFs on surfaces

Multifunctional Nanocarriers

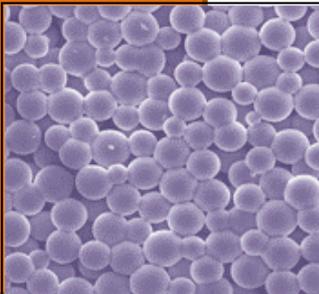
(Since 2012)

Technology
Transfer



Micro- and Nanoencapsulation Technologies

(Since 2011)



1.3. The Project

BIOCIDE²LIFE

Micro- and Nano-encapsulated Biocides: the next generation of Disinfectants with Short + Long-2Life Antimicrobial Activity

- Nosocomial infection (surgical wounds, urinary and respiratory tract).
- Mayor causes of death and increase morbidity in hospitalized patients.
- Suffering by 8.7% of hospital patients.
- Occurs on intensive care units, acute surgical and orthopedic wards.
- Microorganism involved: bacterial, viruses, fungi, yeast and parasite.
- Cost: 4.5 Bi€/year, 100.000 death/year.

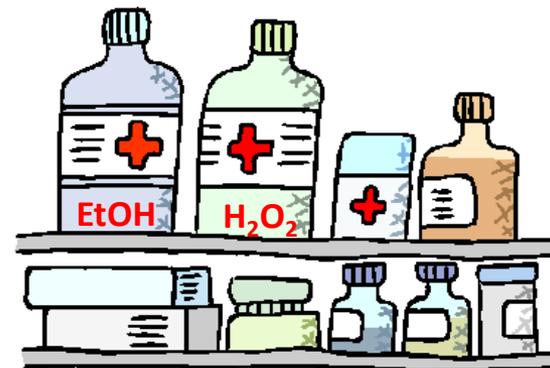


Operating theater

- Reduce or eliminate the microorganism number.
- Minimizing the risk of consequences for patients that receive it or the surface on which it is used.
- Biocides of long-life antimicrobial effect is market demanding.
- 100 disinfectant companies in Europe with 10.000 employees (2011).
- Disinfectant production achieved a turnover of € 3.000 billion € in 2011.
- It is expected a turnover of 5.000 billion € in 2020 with an average annual growth rate above 6%.



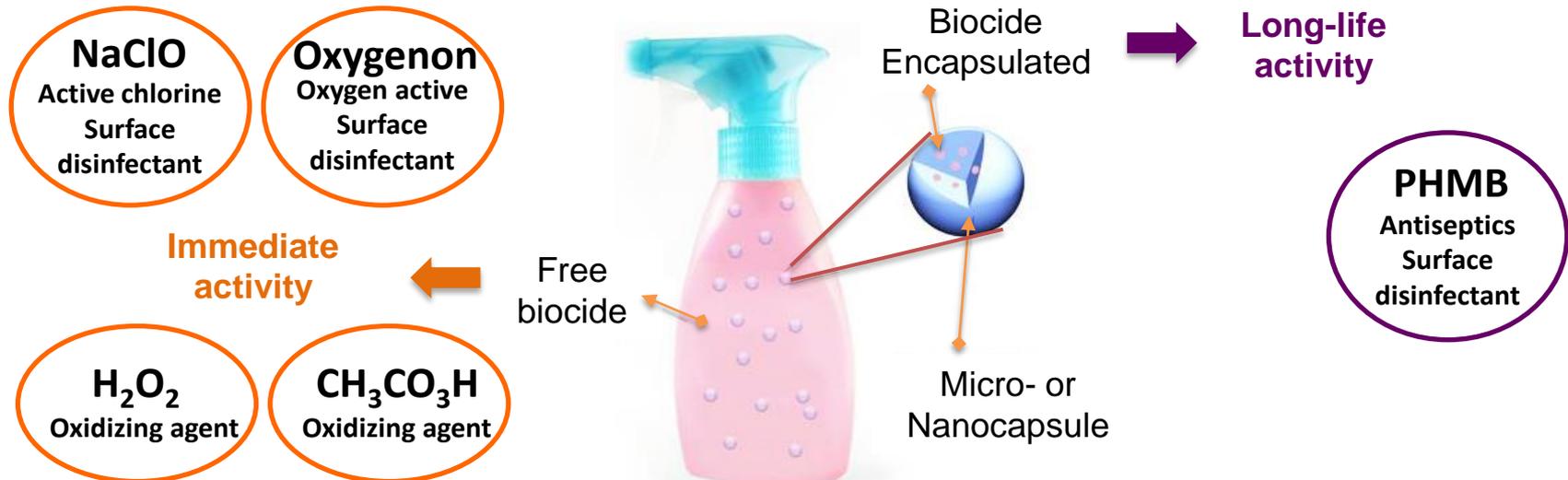
Surfaces: Disinfectants



Skin: Antiseptics

The next generation of biocides:

Encapsulated Biocides

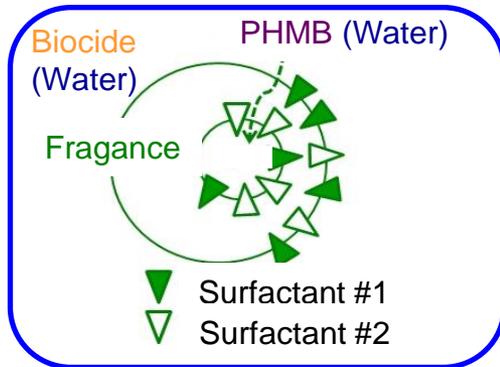


- Non-irritant and non-toxic
- Immediate activity
- 12 hours minimum of long-term activity
- Avoid cross-contamination between hands-surface
- Cost-effective, easy to use, scale-up
- Non visible once applied on a surface
- Stable for 2 years (stock and transport)

W/O/W Double-Emulsion Technology



Prototypes (4)



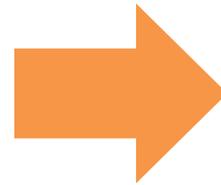
- Non-irritant and non-toxic
- Non-visible once applied on a surface
- Stable for 2 years (stock and transport)
- Cost-effective, easy to use, scale-up

- Immediate biocide activity
- Long-life biocide activity:
 - Effective 3 days
 - Effective after 5 recontaminations

Excellent results of *BIOCIDE²LIFE* in terms of the **immediate activity** and **long-life activity**, **prototype stability** and the **cost-effective** and **easily scale-up** fabrication method have made this Technology very attractive for Worldwide Leading Companies in the field of hospital disinfection.

Patentability Exam.

FTO studies have shown that these products can be commercialized worldwide without infringing any valid intellectual property rights.



2013

Know How and Technology
Transfer Agreement

Design, fabrication and technology transfer to a Catalan company the **BIOCIDE²LIFE** family:

- “PHMB/O/NaClO”
- “PHMB/O/Oxygenon”
- “PHMB/O/H₂O₂”
- “PHMB/O/CH₃CO₃H”

On going work:

- **Optimization and validation** of the **fabrication process** for industrial scale-up.
- Design of **production facility & equipment acquisition** for production at mass scale.
- **Biocide real test** in **Catalonian hospitals** to evaluate **BIOCIDE²LIFE acceptance**.
- **BIOCIDE²LIFE biocide reproducibility** will be validated in **international labs**.
- **BIOCIDE²LIFE products** will be launch to the **market**.

- Disinfectant production achieved a turnover of € 3.000 billion € in 2011; and it is expected a turnover of 5.000 billion € in 2020 with an average annual growth rate above 6%.

4-5 M€ (2019)

- 100 disinfectant companies in Europe with 10.000 employees (2011).

3 direct employees (PROVAT) + 5 new employees (2015)

- Nosocomial infection is the major cause of death and increase morbidity in hospitalized patients (8.7% of hospital patients)

Estimated Impact (Spain): 270.000 patients (1%; 2700 patients die annually)
(3%; 7600 patients die, indirectly)

1 % reduction means saving lives: 270; 760 annually, only in Spain. 

Acknowledgements



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Unió Europea
Fons Europeu de Desenvolupament Regional
"Una manera de fer Europa"



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