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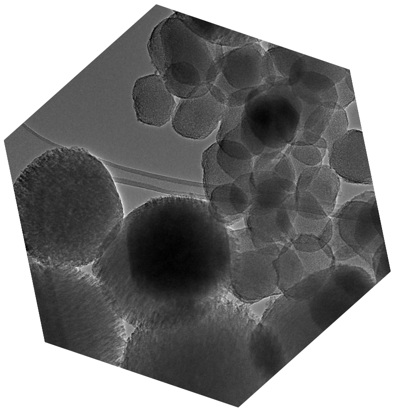
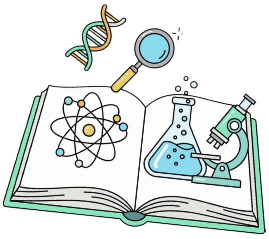
What is the challenge?



Modern societies face linked environmental and health challenges that require smarter materials and sensors. Water systems carry a cocktail of contaminants from heavy metals to pharmaceutical residues that resist standard treatment. Fresh food suffers spoilage and microbial contamination during transport and storage, creating waste and safety risks. At the same time, industry and healthcare need faster, cheaper and more portable sensors to monitor gases and biomarkers for process control and early diagnosis.



These problems demand materials that are not only effective at the molecular scale but also safe, affordable and ready to work in real-world settings.

Our solution

NANOEMCA develops a family of engineered, porous silica materials known as periodic mesoporous organosilicas, or PMOs. Picture a highly regular, sponge-like framework whose internal walls can be custom-built with organic linkers and loaded with tiny metal species or enzymes.

This mix of control and versatility opens practical routes to

- Cleaner, more selective adsorbents for water treatment (photocatalysts that break down persistent pollutants under low-energy light)
- Active packaging that slowly releases natural antimicrobials to extend shelf life
- Sensitive electrochemical or gas sensors for environmental and clinical monitoring.

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Our methodology

NANOEMCA brings together universities, research institutes and SMEs to move PMOs from a concept to the real world. The project follows four complementary synthesis strategies that balance performance with sustainability, and each material is characterized with advanced tools so structure and performance are correlated at every stage.

Every material is checked with standard tools so we know exactly what it looks like and how it behaves. We test materials the way they will be used, in real-life mimicking scenarios. At every step we also run Life Cycle Assessment and Life Cycle Costing to compare environmental impacts and costs between methods. This helps us choose options that are both effective and practical to scale.

Expected results and outcomes of the project

- A set of well-characterised PMO nanoreactors with known pore sizes, surface chemistry and metal contents.
- Several demonstrators ready to evaluate, oriented towards the project objectives (water, environment, food packaging)
- Open data and training materials, shared on trusted repositories so other researchers and companies can build on them.
- Sustainability and cost reports, with LCA and LCC analyses for the suitability of each synthesis and application route.
- Trained people and new partnerships. Early-career researchers will gain hands-on experience through secondments, and we will set up new links between universities and SMEs for pilot projects.

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