NanoTheC-Aba

CECs and AMR bacteria pre-concentration by ultra-nano filtration and Abatement by ThermoCatalytic Nanopowders implementing circular economy solution

PROJECT PARTNERS

UNITO - Torino University, Chemistry Department (Italy, *coordinator*)

CNR-ISMN - National Research Council - Institute for the Study of Nanostructured Materials (Italy)

AAU - Aalborg University (Denmark)

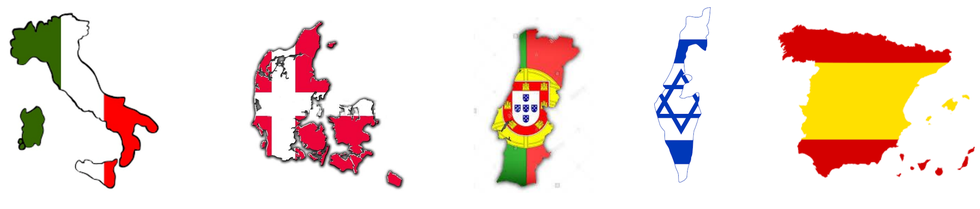
LQT - Liqtech Ceramics A/S (Denmark)

CeNTI - Centre for Nanotechnology and Smart Materials (Portugal)

Subcontractor: **Bar Ilan University** (Israel)

Associated Partners: MICAMO srl (Italy), Fonte Nuova srl (Italy), Società Agricola San Biagio (Italy), Aquanex (Spain)

Consultant for project management: **Project-HUB** (Italy)



CONTACTS

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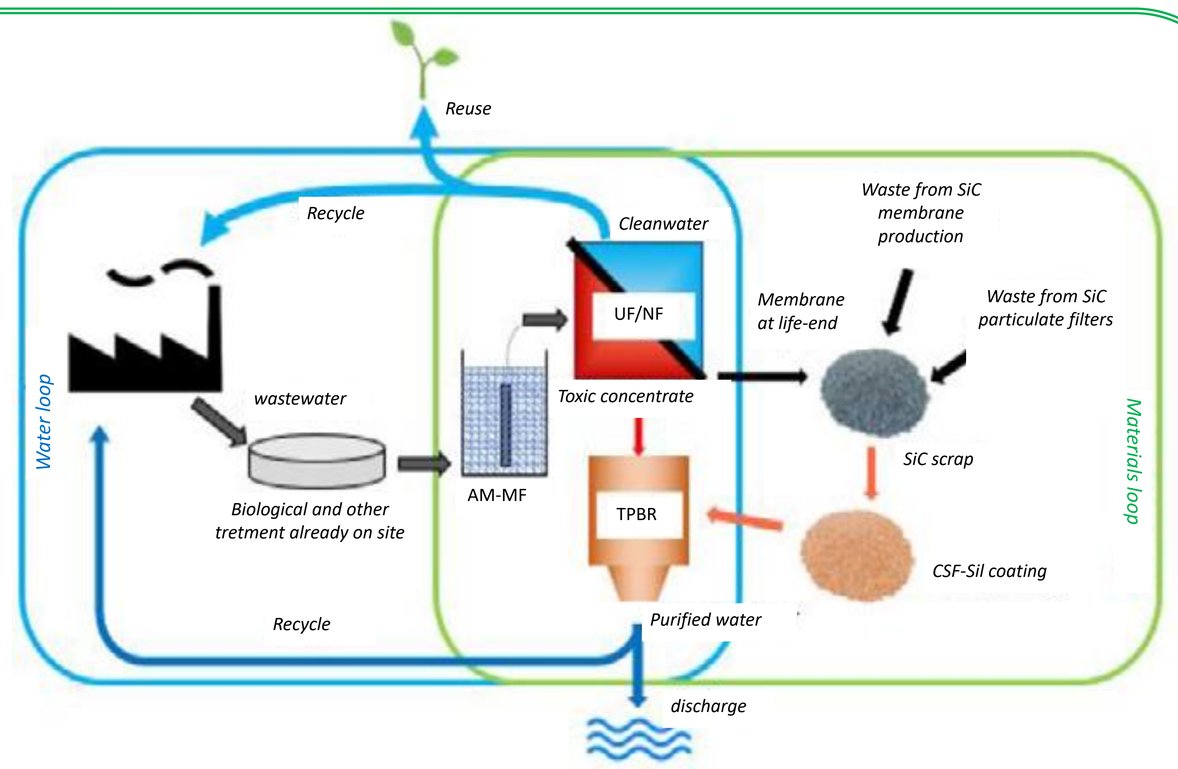
Project website (to be released): www.nanothecaba.unito.it

ABSTRACT

The project will deliver an energy efficient new integrated prototype system for water purification, composed of:

- the first-to-be realised **ultra-stable silicon carbide (SiC) UltraFiltration/ NanoFiltration (UF/NF) membrane** for pre-concentration of the CECs contaminated water,
- an innovative **nano-enabled thermocatalytic energy efficient packed-bed reactor (TPBR)** for the generation of OH radicals able to abate CECs and residues of AMR bacteria via an Advanced Oxidation Process (AOP), and
- a **nano-enabled antimicrobial MicroFiltration (MF) membrane**.

The **TPBR beads** are obtained by recycling **SiC membranes scraps** deriving from the ordinary production process and will be coated with **thermocatalytic perovskite-nanopowders** allowing full abatement of Contaminants of Emerging Concern (CECs) and of Antimicrobial Resistant (AMR) pathogens at mild temperatures without need of chemicals and light sources. The MF membrane is coated with **antibacterial titania-silica-core shell nanoparticles** for inactivating AMR bacteria, while removing suspended solids. The UF/NF membrane separates the clean permeate stream, ready to be recycled or reused, from the toxic concentrate, which is purified by the TPBR, thus preventing discharge of CECs and pathogens in rivers and oceans.



The new system is compact, amenable to scale-up, and ease to integrate in mariculture, aquaculture, tannery, hospital, and other industrial wastewaters treatment facilities, providing safe and efficient operation. The integration of the three components allows the optimization of each system unit both alone and in combination, boosting the efficiency of the process and **ensuring high water quality and safety**, by enabling a water and SiC recycling multi-circular model.

OUTCOMES AND EXPECTED IMPACT

NanoTheC-Aba proposes a solution that combines **pre-concentration, antifouling, high filtration efficiency, CECs abatement, operation safety, simplicity, robustness** with respect to the Reverse Osmosis system complexity, **cost effectiveness and no consumption or waste of natural resources**.

The integrated one-step water treatment prototype system aims at providing abatement (> 99%) of the largest spectrum of CECs and AMR-pathogens, regardless their chemical or biological nature, and the complete reuse of process effluents, thus minimizing disposal of wastewater in the environment, reducing the water treatment cost of at least 30% in the four case studies while keeping low the running costs of the process.

The project involves the investigation of the following relevant aspects:

A) **Generation of antibacterial SiC membranes for AMR pathogens abatement**, by using nanoparticules (NPs) with enhanced antibacterial activity immobilized on SiC flat membrane by spray coating

B) **Functionalized beads for packed bed reactor**: The perovskite-based nanopowder (NPW) will be deposited on beads produced by SiC-based membranes scraps through innovative sonochemical techniques following circular economy model.

NanoTheC-Aba project offers a viable implementation to solve **the issue of the CECs abatement** for human and environmental safety, providing a **better water quality**. This will benefit people at large providing a measurable positive impact on society and health.

The integrated apparatus can be applied without any change in the existing wastewater treatment system, covering different sectors such as hospitals, tanneries, aqua-mariculture, industrial wastewater, agriculture, utilities.

The involvement of one of the leading global company in SiC membranes production will offer the unique opportunity for global industrial exploitation of the developed results and their application in different industrial and public sectors. The technological impact is also relevant for the development of the first SiC NF membrane opening up revolutionary applications.

Providing differential scale filtering stages combined with the simultaneous abatement of CECs and AMR pathogens makes NanoTheC-Aba project a unique, disruptive solution for future environmental and safety global challenges.

The project is organized in 5 WPs:

WP1 - UF/NF membrane and prototype development

WP2 - Thermocatalytic NPW and AM NPs synthesis and optimization

WP3 - Coating solutions for SiC membranes

WP4 - System integration testing & validation

WP5 - Management, dissemination, exploitation

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