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nanoparticles for **HER**itage **CUL**ture in **E**nvironmental **S**ustainability

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Department of Engineering for Innovation in Medicine (DIMI)



PROJECT GOAL

Taking up the challenge of producing materials for applications in cultural heritage conservation assuring healthcare safety and low environmental impact

DEVELOPING SUSTAINABLE AND SCALABLE SYNTHESIS PROCEDURES FOR THE PRODUCTION OF NANOMATERIALS

UN Sustainable development goals met by the *nanoHERCULES* project



SCIENTIFIC TOPICS

- SURFACE SCIENCE AND NANOSTRUCTURES
- CHARACTERIZATION METHODS OF MATERIALS
- NANOMATERIALS ENGINEERING



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PROGETTI DI RICERCA DI
ELEVANTE INTERESSE
NAZIONALE

PROJECT PARTNERS



Department of Engineering
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KEY POINTS OF THE PROJECT

→ *Development of **alkaline earth hydroxides and metal oxide nanoparticles** for the conservation of cultural heritage*

INNOVATIVE SYNTHESIS: sustainable, scalable, high-yield, in water, at room temperature and without chemical additives

APPLICATION :

- on historic **stone** and buildings
- on **cellulose** artifacts for consolidation and protection

MULTIPLE FEATURES: consolidation + antimicrobial and antifungal properties (addition of zinc and copper oxides)



OBJECTIVES

IN SYNTHESIS IMPROVEMENT

- ONE-STEP SUSTAINABLE PROCESS
- “GREEN ROUTE”
- SCALABLE

IN CONSERVATION APPLICATIONS

- AESTHETIC
- COMPATIBILITY
- PENETRATION DEPTH
- MECHANICAL PROPERTIES

PROJECT KEYWORDS

- NANOPARTICLE SUSTAINABLE SYNTHESIS
- GREEN METHODS
- ECO-FRIENDLY AND LARGE-SCALE PRODUCTION AT LOW COST
- CULTURAL HERITAGE CONSERVATION TREATMENTS
- MATERIALS FUNCTIONALIZATION



THE NANO MATERIALS

THE NANO-MATERIALS PRODUCED AND STUDIED

- PURE NANO CALCITE in water
- NANO CALCITE + IRON
- NANO CALCITE + ZINC
- NANO CALCITE + MAGNESIUM

with different DRYING and
FABRICATION procedures

CHARACTERIZATION / ASSAYS

- CRYSTALLINE PHASES IDENTIFICATION
- SIZE DISTRIBUTION AND MORPHOLOGY
- STABILITY IN WATER
- COMPATIBILITY COLORIMETRIC TEST
- TOXICITY IN CELLS
- ANTIMICROBIAL ACTIVITY
- AGEING RESISTANCE (MICROORGANISMS,
SALTS AND LIGHT EXPOSURE)



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PROGETTI DI RICERCA DI
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PROJECT MANAGEMENT

NPs FUNCTIONALIZATION



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NPs SYNTHESIS



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CHARACTERIZATION



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**APPLICATION AND
PROPERTIES EVALUATION**



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UPSCALING EVALUATION



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TIME SCHEDULE



1° YEAR project





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PROGETTI DI RICERCA DI
RILEVANTE INTERESSE
NAZIONALE

FUNDINGS



PI: DALDOSSO
Nicola

Total: 88.605 €



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PI: TAGLIERI
Giuliana

Total: 127.704 €



PI: TOMASIN
Patrizia

Total: 129.958 €



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PI: CATTARUZZA EIti

Total: 95.114 €

Total funding: 441.381 €



NPs SYNTHESIS



T = 25°C

