SUN-SNO-GUIDENANO Sustainable Nanotechnology Conference 2015
Monday, Mar. 9 – Wednesday, Mar. 11
Venice, Italy

Nanomaterials and Sustainability in the fields of Architecture and Preservation of Cultural Heritage

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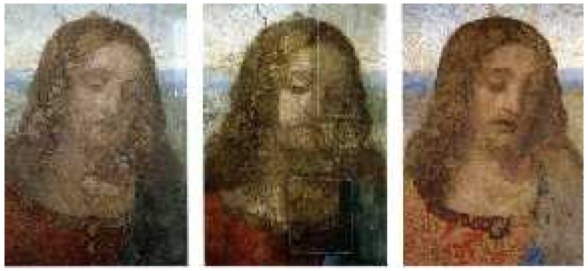
www.masternanotecbc.it

APPLICATIONS FOR BUILDING CONSTRUCTION

SUSTAINABILITY



Reduce the environmental footprint of the building environment

MORE SUSTAINABLE BUILDING MATERIALS

EFFICIENT USE OF ENERGY AND RESOURCES

NANOMATERIALS FOR ARCHITECTURE

- Improving the performance of building materials
- Increase durability and reliability of the building elements
- Improving energy efficiency and safety of the buildings
- Reducing the environmental impact through sustainable materials
- Simplifying and reducing maintenance works
- Providing greater comfort of life inside the rooms

STRUCTURE

SURFACES

CONCRETE

NANO ADDITIVES → NEW PROPERTIES

NANO ADDITIVES

- **Metal nanoparticles**
- **Nano-silica fumes**
- **Carbon nanotubes**
- **Carbon nanofibers**

NEW PROPERTIES

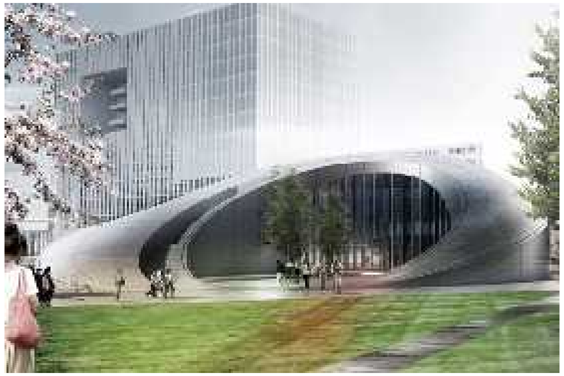
- Higher mechanical strength
- Increased durability
- Self-cleaning
- De-polluting/purifying properties
- Increased fire resistance
- Faster curing process

GLASS AND SMART WINDOWS

- **THIN FILM COATINGS**
- **THERMOCHROMIC TECHNOLOGIES**
- **PHOTO-CHROMIC TECHNOLOGIES**
- **ELECTRO-CHROMIC COATINGS**

INSULATING

- Aerogel
- Vacuum insulation panel
- Thermal Wrap
- Energy efficiency paintings

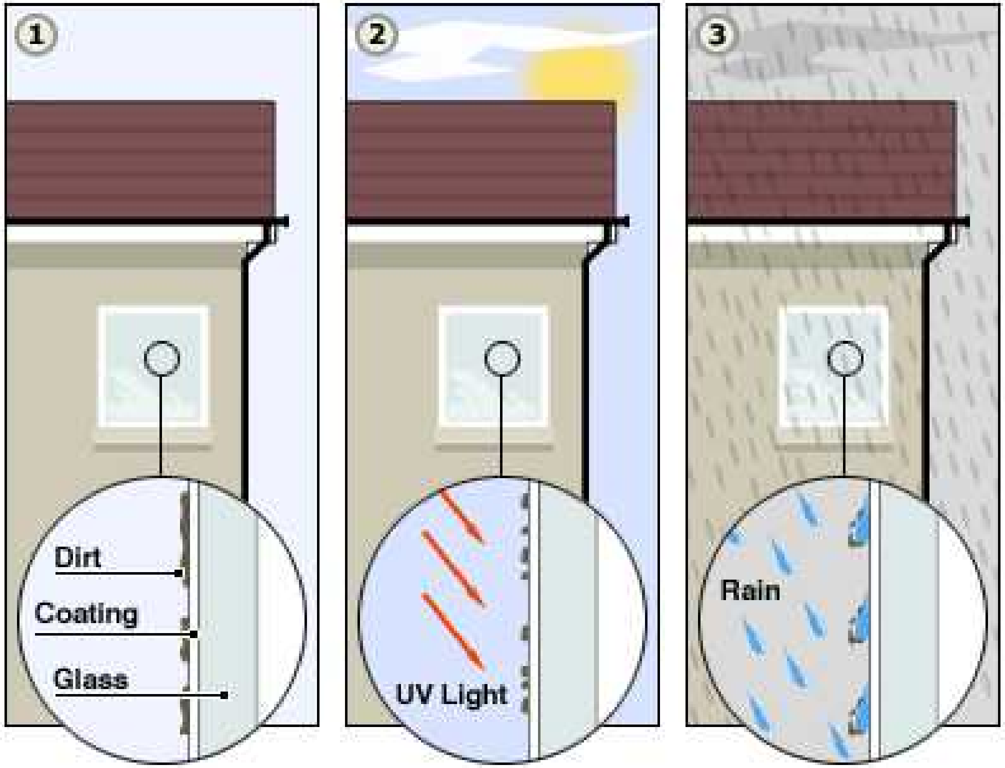


COATINGS FOR INTERIOR APPLICATIONS

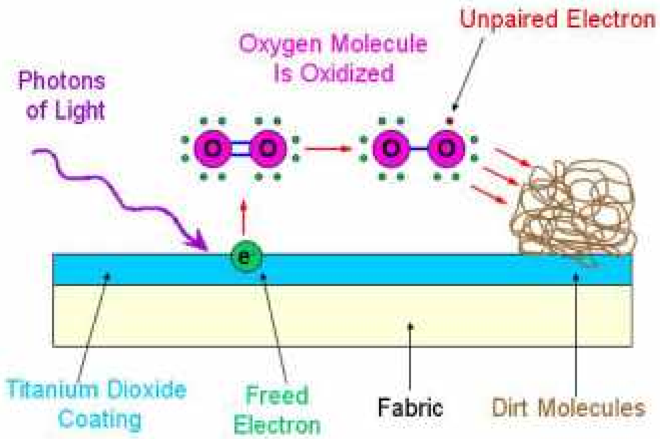
- Self-cleaning and / or anti-pollution
- Sanitizing and antibacterial activity
- Scratch resistance
- Anticorrosion for iron
- Fire retardant for wood

COATINGS FOR EXTERNAL

TiO_2 PHOTOCATALYTIC ACTION



- Self-cleaning
- Anti-bacterial
- De-pollutant
- Reduction of maintenance



TiO_2 PHOTOCATALYTIC ACTION

- Transparency in the visible region
- High surface affinity
- Ensures the breathability of the support

- Chemical inertness
- Low cost and easy to produce

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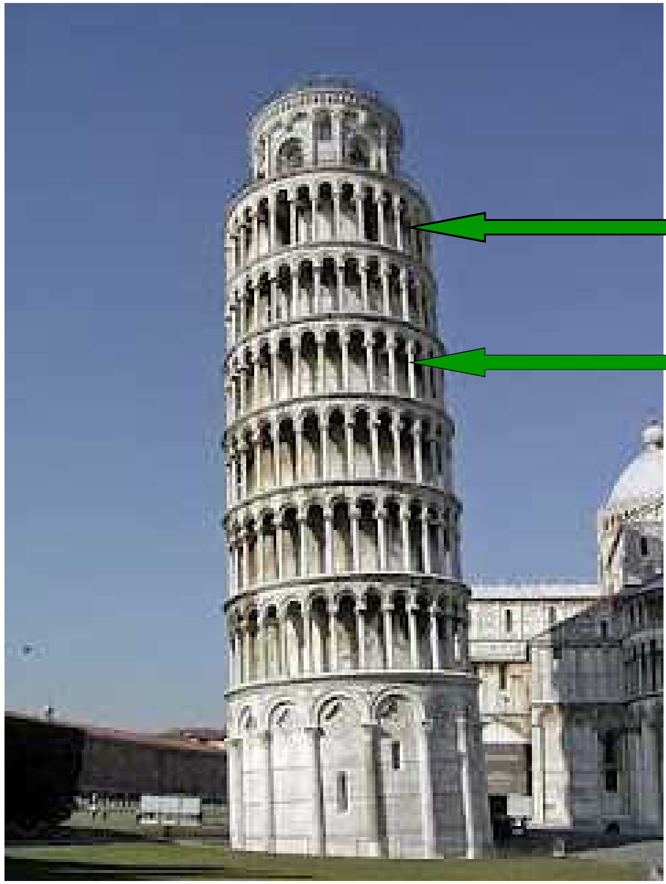
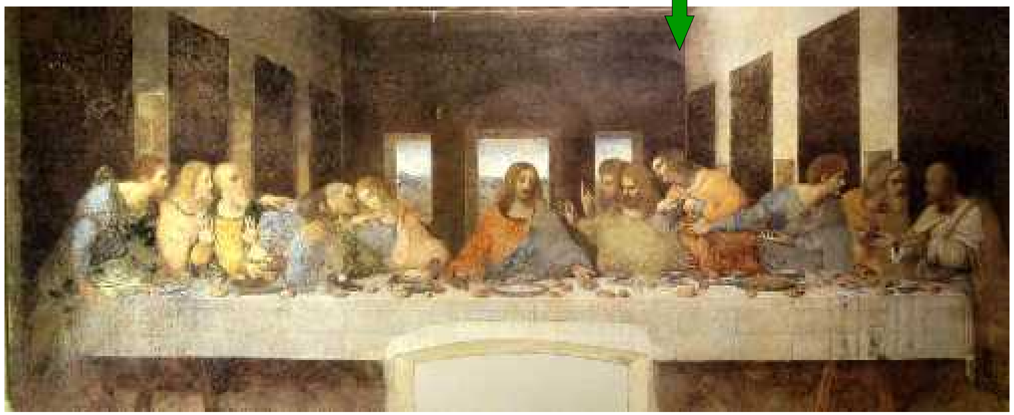
APPLICATION OF NANOTECHNOLOGIES TO CULTURAL HERITAGE



Titanium dioxide nanoparticles

Nanosilica

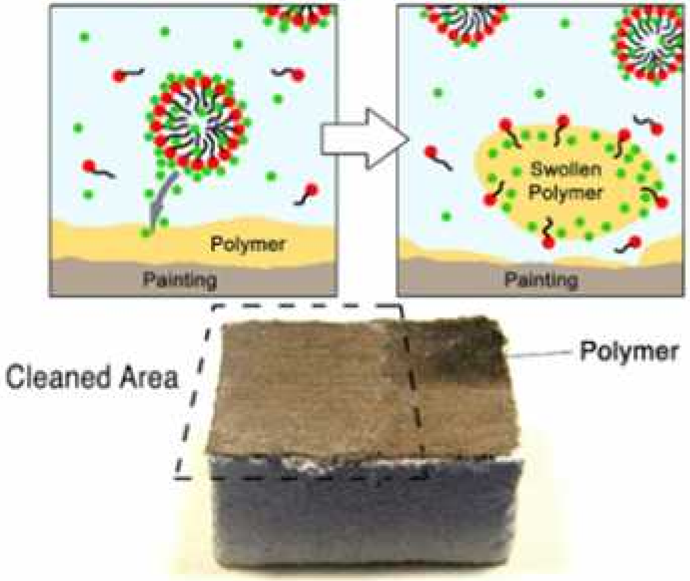
Calcium Idrixide nanoparticles



APPLICATION OF NANOTECHNOLOGIES TO CULTURAL HERITAGE

- CLEANING
  Nanostructured cleaning systems
- CONSOLIDATION
  Calcium hydroxide nanoparticles
  Silica nanoparticles
- PROTECTION
  Water repellency
  Self-cleaning
  Anti-bacterial
  Depolluting
  Controlled-release biocides
- MONITORING
  Mininvasive advanced sensors
  Non-destructive diagnostics

CLEANING SYSTEMS



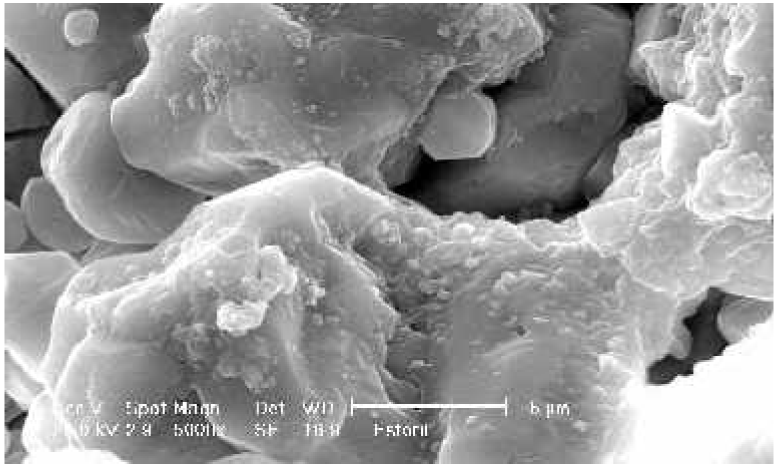
- Micellar solutions and microemulsions for the removal of degraded synthetic resins
- High retention chemical gels for selective cleaning of surfaces sensitive to water and to polar solvents
- Dispersions of magnesium and calcium nanoparticles for the deacidification of paper items

(Fonte: Carretti E, Giorgi R., 2007)

CONSOLIDATION: CO_2 NANOPARTICLES

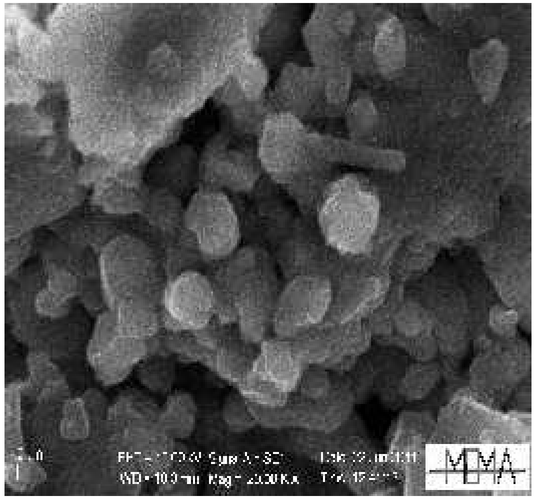
Calcium hydroxide nanoparticles in isopropyl alcohol:

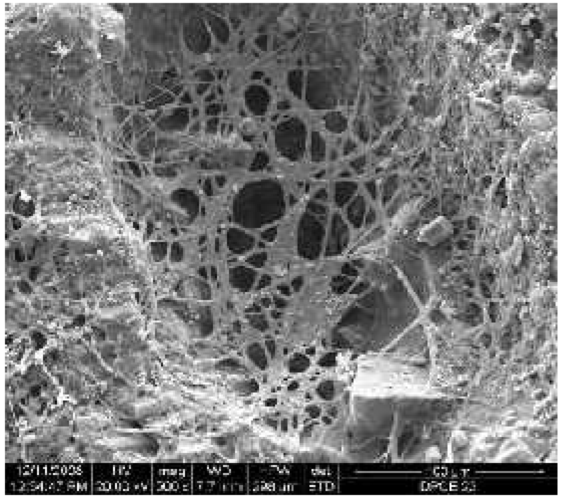
- compatible
- greater penetration
- delayed time of carbonation



CONSOLIDATION: SILICA NANOPARTICLES

Silica nanoparticles in aqueous solution:
- compatible
- treatment works in presence of moisture
- shorter access times (3-4 days)





PROTECTIVE TREATMENTS

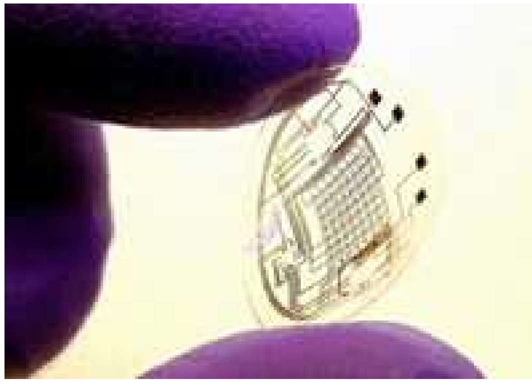
Surface treatments for stone, wood, plaster, ceramics that confer characteristics of:

- Hydro-oil repellency
- Self-cleaning against smog and biodeteriogens

while maintaining color characteristics and water vapor permeability of the treated materials

DIAGNOSTIC AND MONITORING

- Diagnostics for non-destructive analysis of the decay
- Imaging and advanced instruments for microstructural characterization of materials
- Development of sensors for real-time monitoring
- Remote control and safety of assets



FIRST CONCLUSIONS

The application of nanotechnology makes a concrete contribution in the field the construction industry and cultural heritage preservation to the following areas:

- Optimization of existing products
- Damage protection
- Reduction in weight and/or volume
- Reduction in the number of production stages
- A more efficient use of materials
- Reduced need for maintenance (easy to clean, longer cleaning intervals) and/or operational upkeep

ISSUES

NANOPARTICLES CAN BE ACCIDENTALLY RELEASED INTO THE ENVIRONMENT AT DIFFERENT STAGES OF THEIR LIFE CYCLE

No adequate informations about the **toxicity** and the **nature** of the nanoparticles used in their products

How they **transform** the environment?

What might happen in case of increase in the **concentration** in the atmosphere?

What might happen in case of **release**?

PERSPECTIVES

Develop a profile of full exposure of the **entire lifecycle** of nanomaterials, to assess the possible effects on human health and the ecosystem

Specific actions are necessary to overcome these issues, i.e.:

- Eurocodes: development of new codes supporting the use of emerging materials and technologies in the construction sector
- Environmental impact of construction materials

CONCLUSIONS

EVEN IF NANOMATERIALS ARE CONTRIBUTING TO A SIGNIFICANT CHANGE IN BOTH SECTORS WE MUST ENSURE THAT THE POTENTIAL RISKS ARE IDENTIFIED AND CONTROLLED, THROUGH DEVELOPING NEW APPROPRIATE STANDARDS AND CODES FOR THEIR APPLICATION

A STRONG INTERDISCIPLINARY COOPERATION IS NEEDED TO PERFORM ALL THE NECESSARY ASSESMENTS OF THE ENTIRE LIFE CYCLE OF THE NEW PRODUCTS TO ENSURE THEIR PROPER SUSTAINABILITY IN TERMS OF POTENTIAL TOXICITY AND HEALTH RISKS

THANKS FOR YOUR ATTENTION

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