National Research Council of Italy

istec

Institute of Science and Technology for Ceramics

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Mission

ISTEC-CNR is the only CNR structure in Italy with long term activity programs on ceramic materials. ISTEC-CNR has its headquarter in Faenza.

According to CNR's mission, the following activities are carried out:

- research,
- technology innovation,
- education,
- consulting/testing.

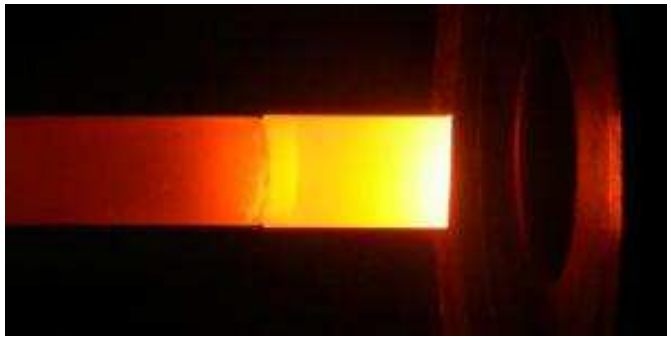
Total CNR personnel: about 8000
Number of Institutes: 107

ISTEC Personnel

- 25 researchers
- 10 technicians
- 5 secretaries
- 30 temporary contract researchers fellowships - students - guests

Annual budget: 4 M€

Research areas



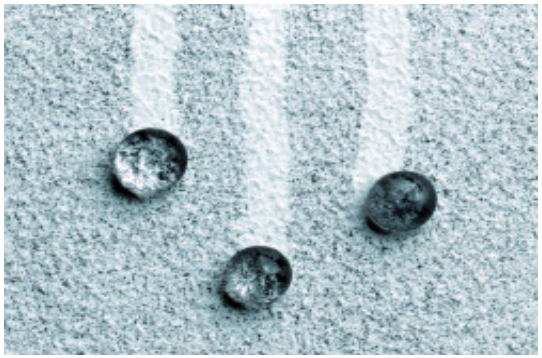
Energy and Environment

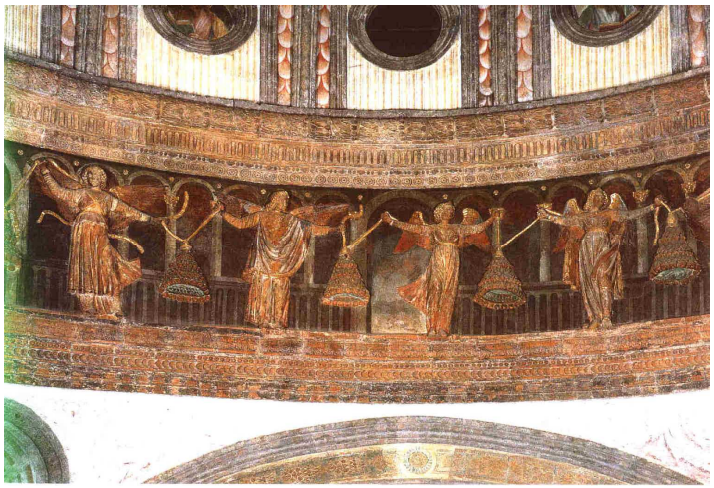
High-Tech Industrial Applications

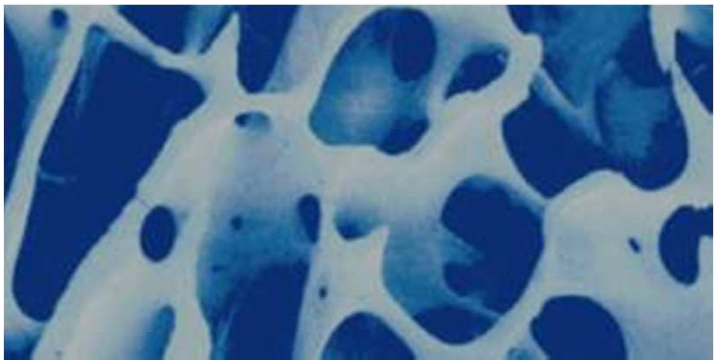
Nanotechnologies & Surface Functionalization

Regenerative Medicine

Cultural Heritage





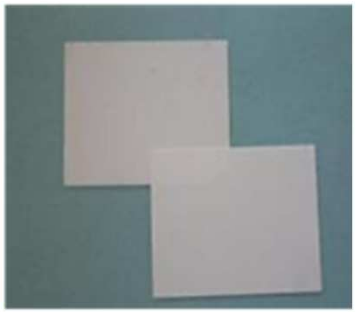


Solid Oxide Fuel Cell

Production of large area ceramic sheets by tape casting (thickness, 0.1-1.5 mm)

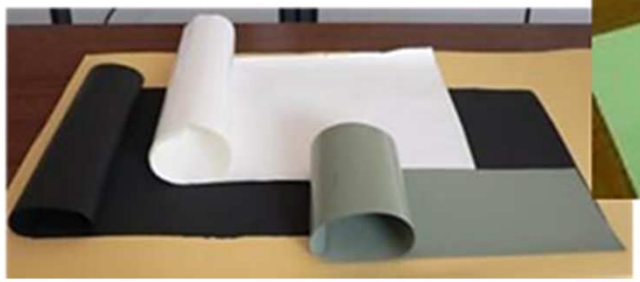
Supporting Anodes
NiO-YSZ, NiO-GDC

Supporting Cathodes
LSCF

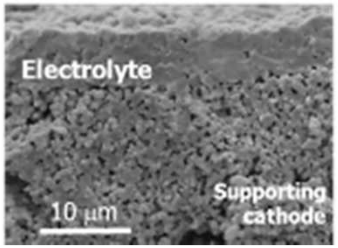


Supporting Electrolytes
YSZ, GDC

Maximum dimensions of tape cast components:
25x400 cm



SOFC elements
Cathodes: LSM, LSCF
Anodes: NiO-GDC, NiO-YSZ
Electrolytes: GDC, YSZ, $BaCeO_3$, $SrCeO_3$

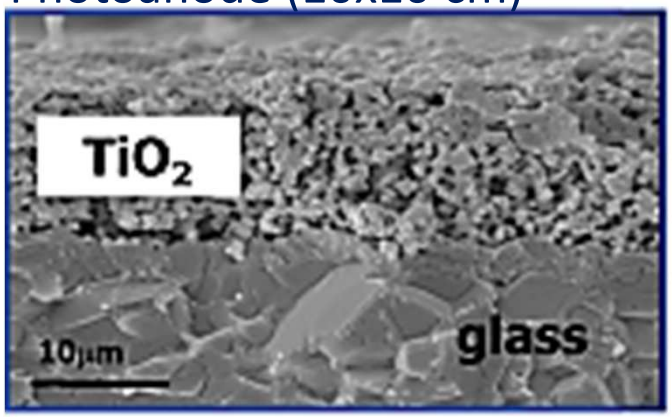


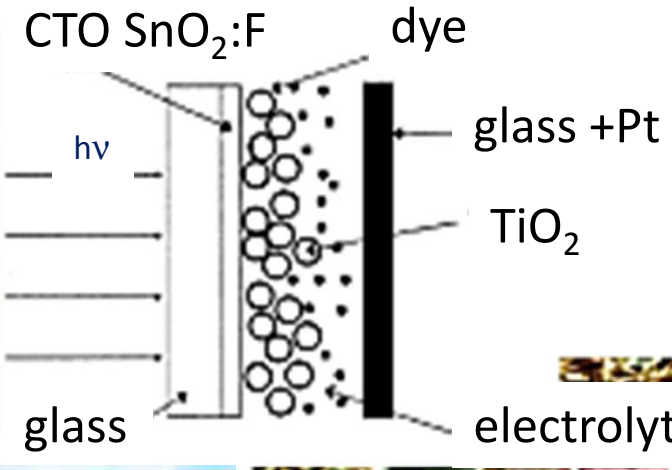
Screen printing of thick films (3-40 µm) with home-made inks

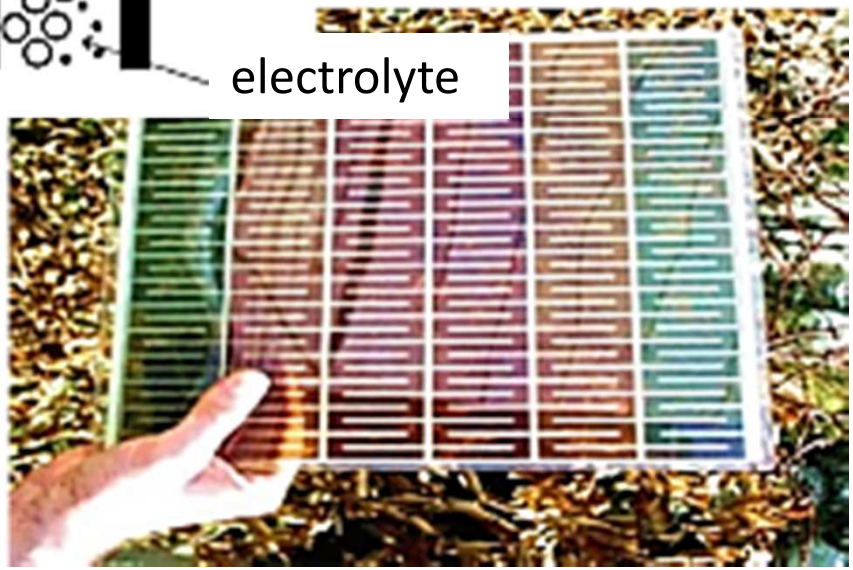
Dye-Sensitized Solar Cells

TiO_2 for photovoltaic applications Dye-Sensitized solar cells DSSC

Photoanode (10x10 cm)



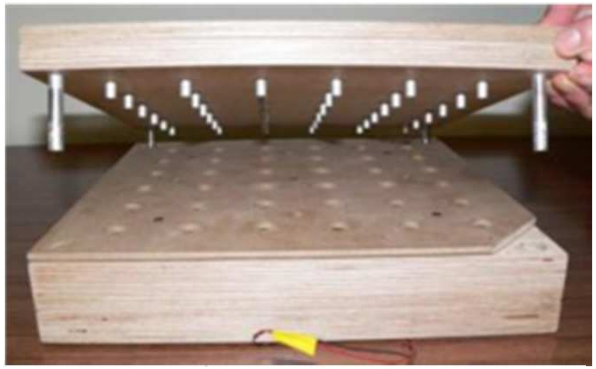


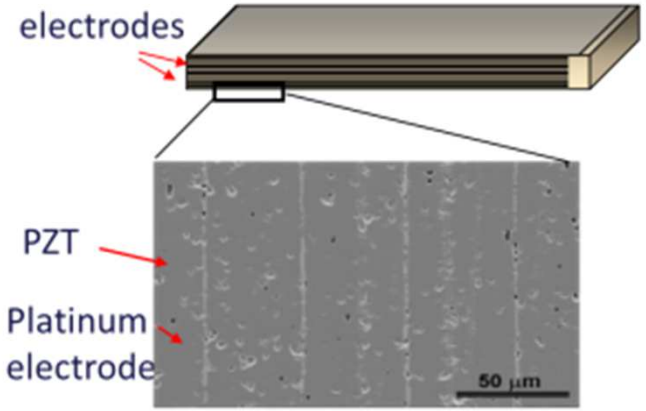


DSSC module for electronics

Piezoelectric ceramics

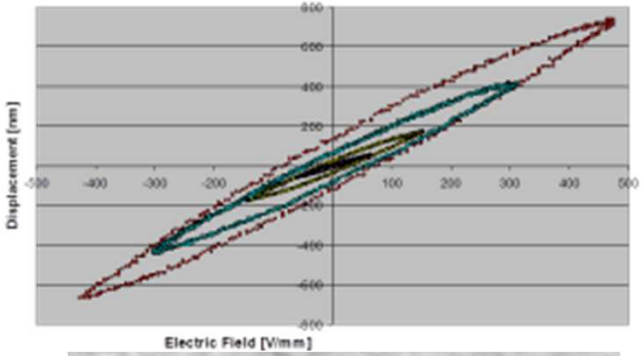
Sensors, actuators, energy harvesting systems

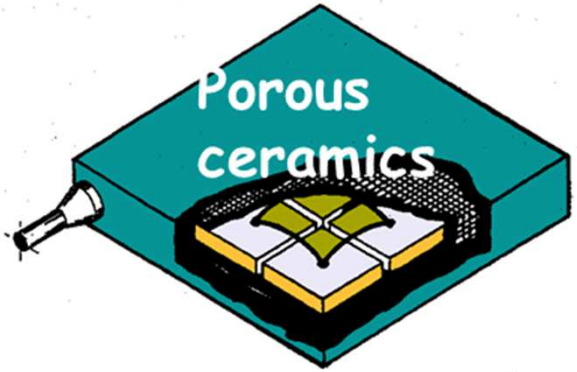




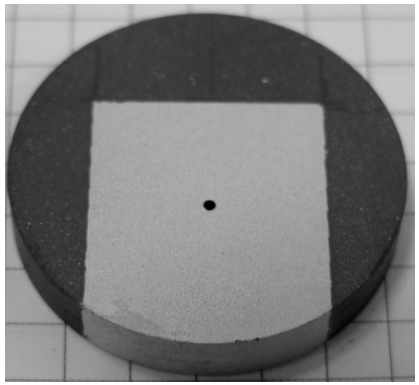
(layer thickness 50 µm)

Multilayer PZT: Bender Actuators

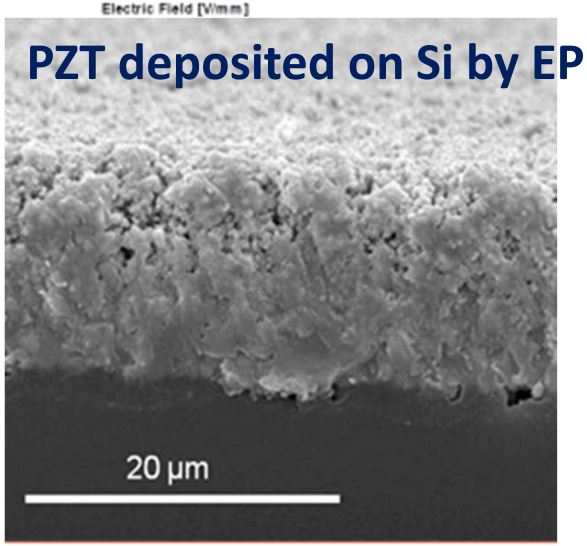




Miniaturized ANTENNA



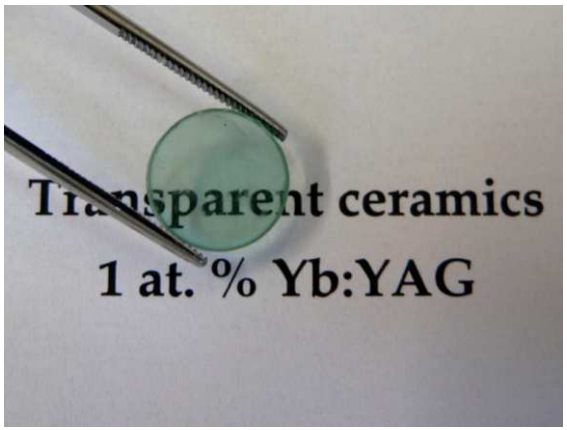
PZT deposited on Si by EPD

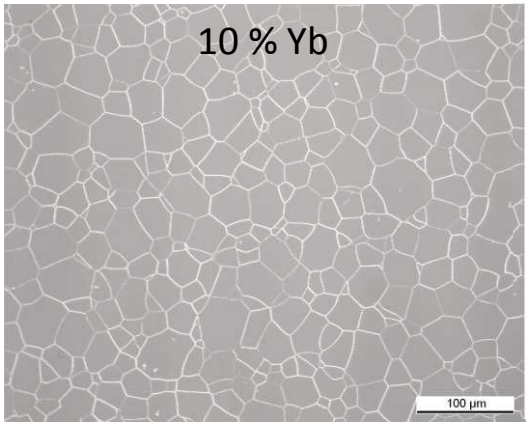


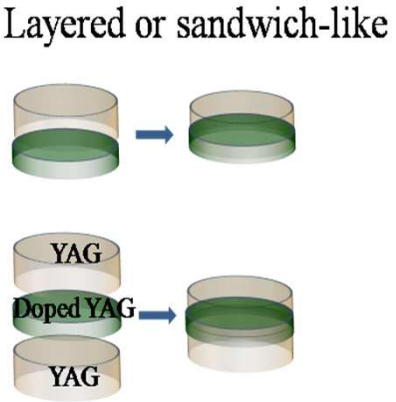
For diagnostics, energy harvesting, antenna miniaturization, structural health monitoring,
vibration damping

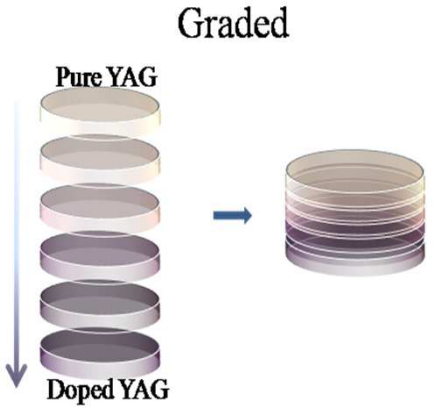
Transparent ceramics: YAG

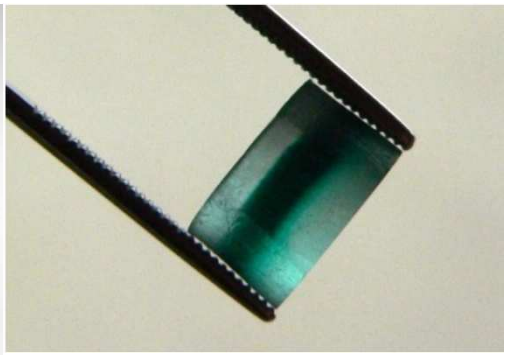
Polycrystalline, rare earth elements (REE) doped **YAG** is a functional material for solid-state lasers. Compared to the more commonly used single crystals, polycrystalline YAG ceramics can be highly doped, cheaper, faster and is easier to produce.

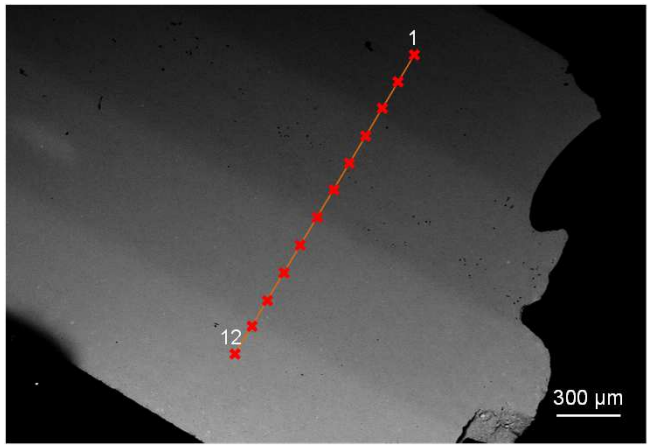










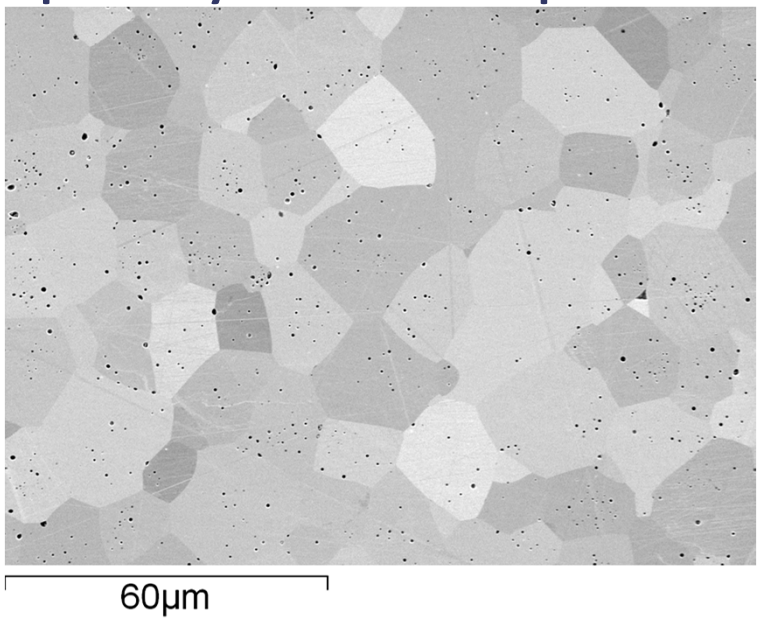


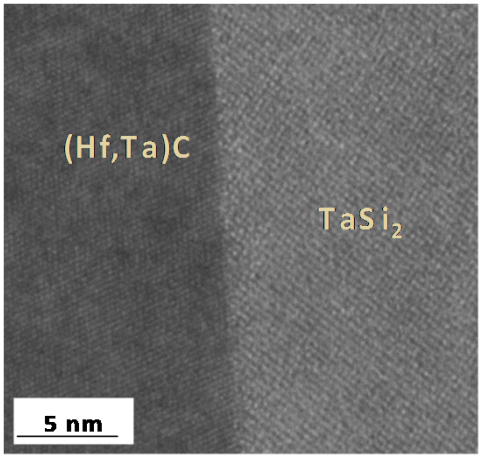
New LED Devices

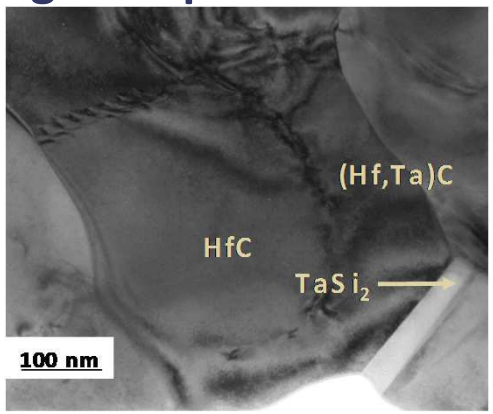
Ultra refractory ceramic for solar absorbers

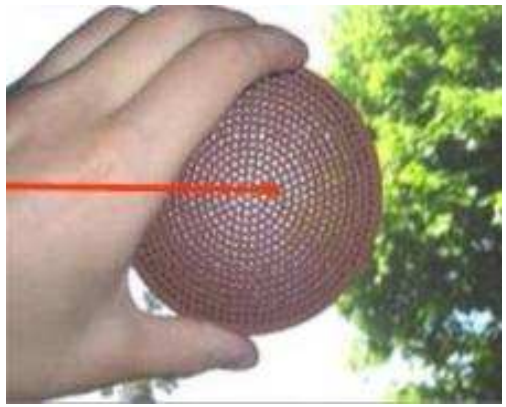
Borides and carbides of early transition metals: ZrB_2, HfB_2, ZrC, HfC, TaC have extremely high melting point, strength, high thermal and electrical conductivity, stability at T>1600°C in aggressive environment

Spectrally selective compounds: solar absorbers at ultra-high temperature



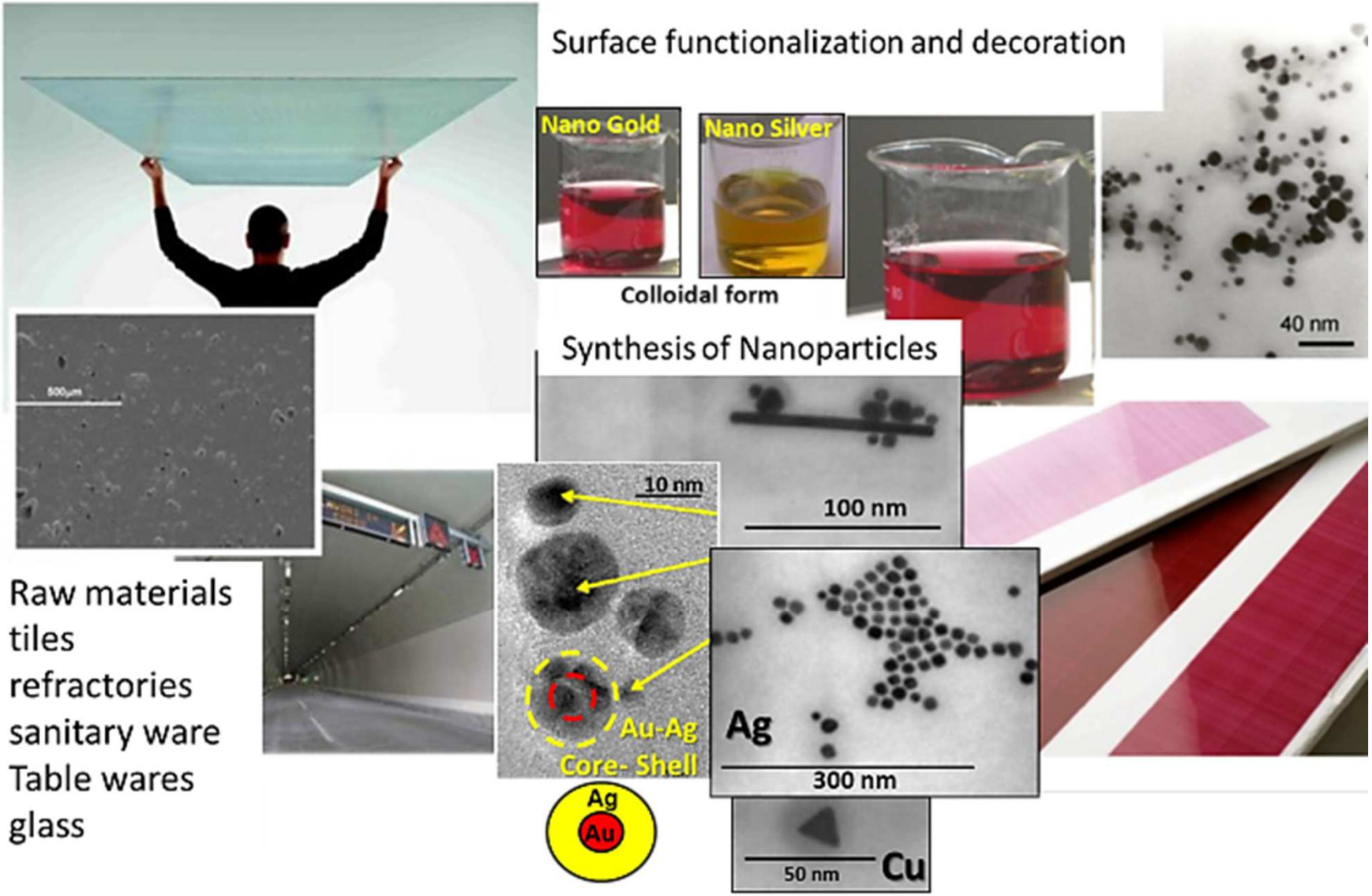






Ceramic solar absorbers for CSP systems

Ceramics for buildings and industrial applications

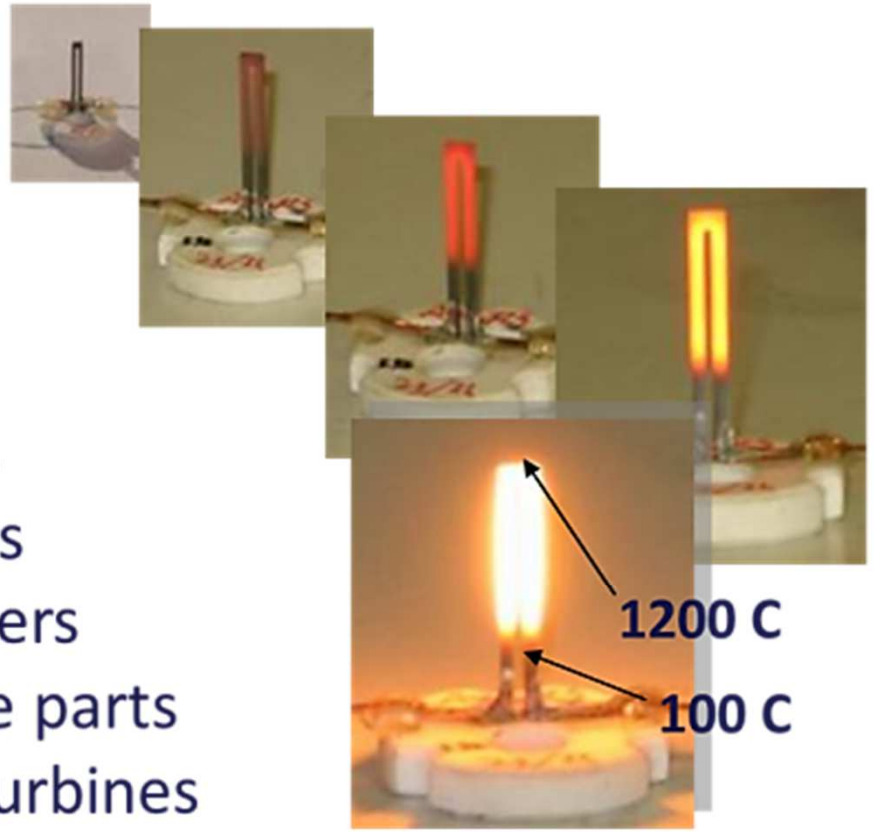


Electroconductive structural ceramics

Insulating ceramics can be converted into electro-conductive ceramics with tailored electrical conductivity upon addition of conductive phases for several applications

Electroconductive composites can be machined by electrodischarge machining (EDM)

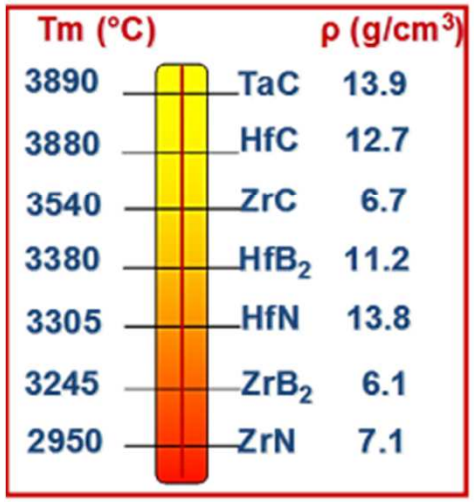
Heaters/ igniters



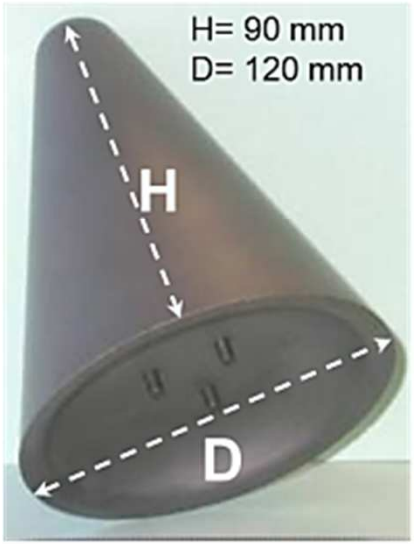
Wear parts
Cutting tools
Thermal barriers
High temperature parts
Components for turbines

Ultra-high temperature ceramics for aerospace

- Borides and carbides of early transition metals: ZrB_2, HfB_2, ZrC, HfC, TaC.
- Extremely high melting point, strength, high thermal and electrical conductivity, stability at T>1600°C in aggressive environment.
- Applications: aerospace, nuclear plants.



Nose cone



Leading edge

Geopolymers

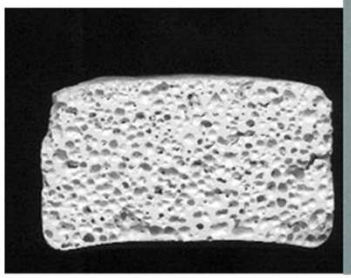
Inorganic polymers based on syntetic alkali-aluminosilicats or phospates of metal oxides.
Geopolymer based materials are consolidated through a chemical reaction at **T<300°C** → NO SINTERING

- Sustainable and eco-friendly
- Excellent burn-through fire resistance
- No toxicity

Applications:
- Fireproof panels for thermal and acoustic insulation
- Refractory items
- Waste recycling
- HT binder and paints

Vermiculite based structural panels for thermal insulation and fire proofing (<1000 kg·m^{-3}, flexural strength 3 Mpa)

Catalysis supports and heat exchangers



Refractory SiC based paint

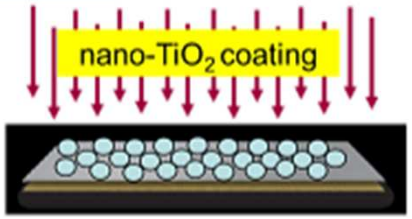
Alkali bonded SiC based foams

Waste recycling in building materials

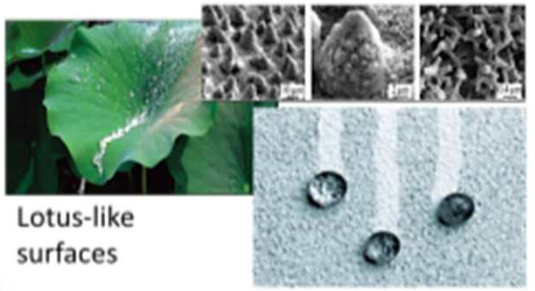
Bio-soluble based light-weight panels (<200 kg·m^{-3}) for thermal and acoustic insulation in naval applications

Development of Smart surfaces

Super-hydrophobic surfaces
Anti-reflective glasses
Anti-ice coatings for aerospace sector

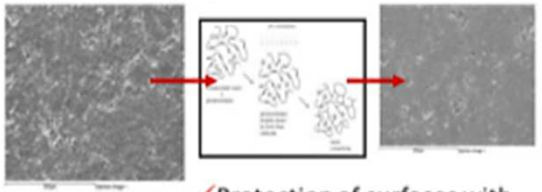


✓Photoinduced hydrophilicity

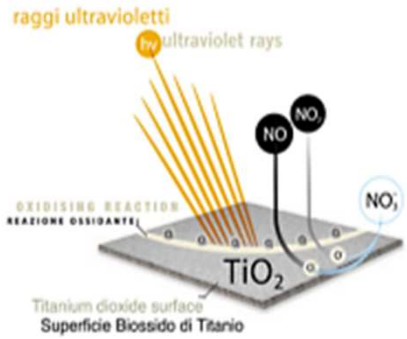


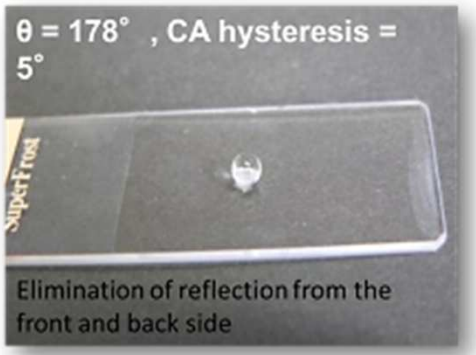
Lotus-like surfaces

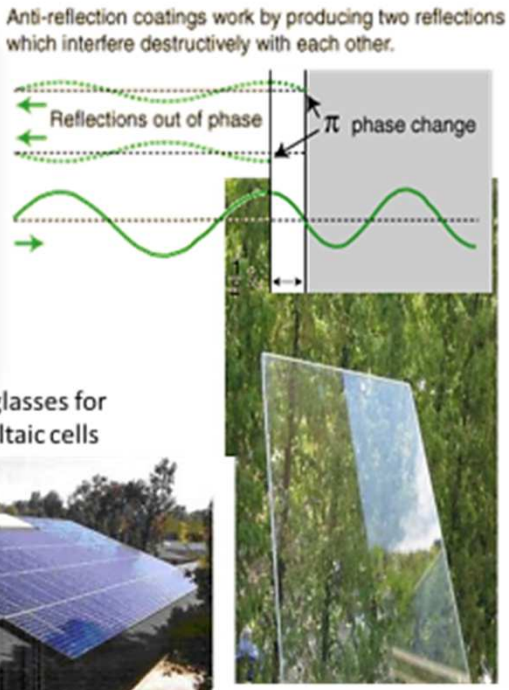
✓Development of methods to get super-hydrophobic surfaces



✓Protection of surfaces with resins, polymers

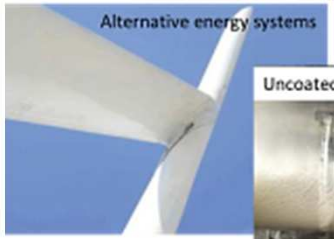


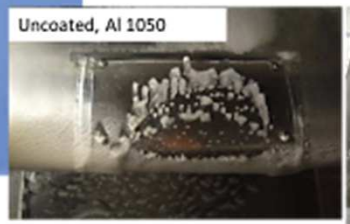


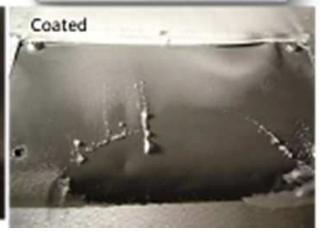


TV/PC screen

Sealing glasses for photovoltaic cells



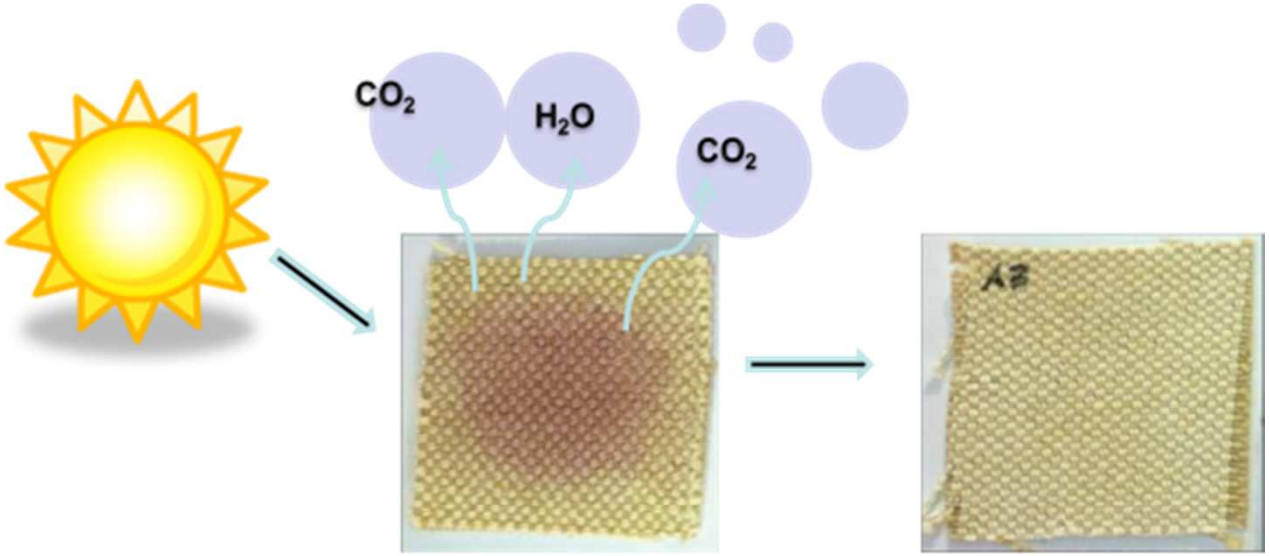


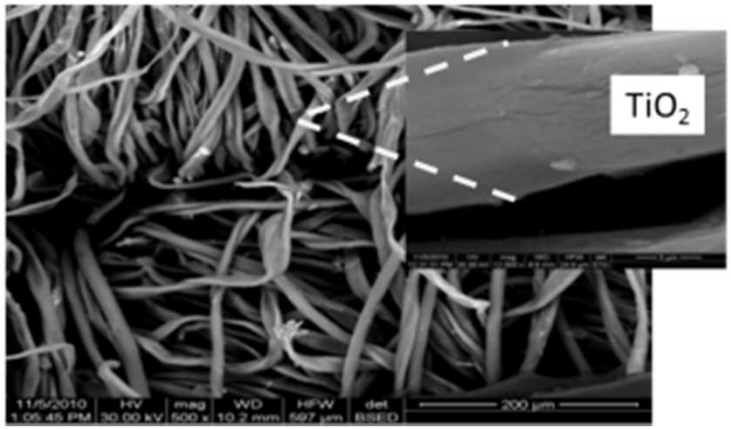


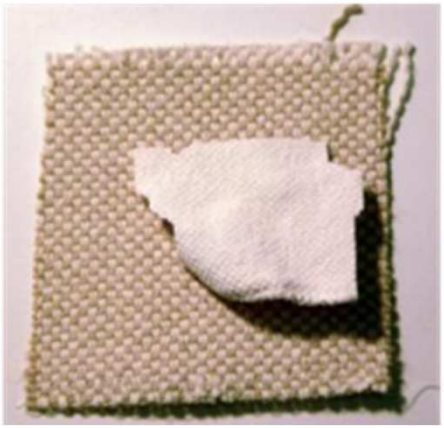
Functionalization of textiles

Photocatalitic properties of nanosized TiO_2.

Self cleaning textiles.

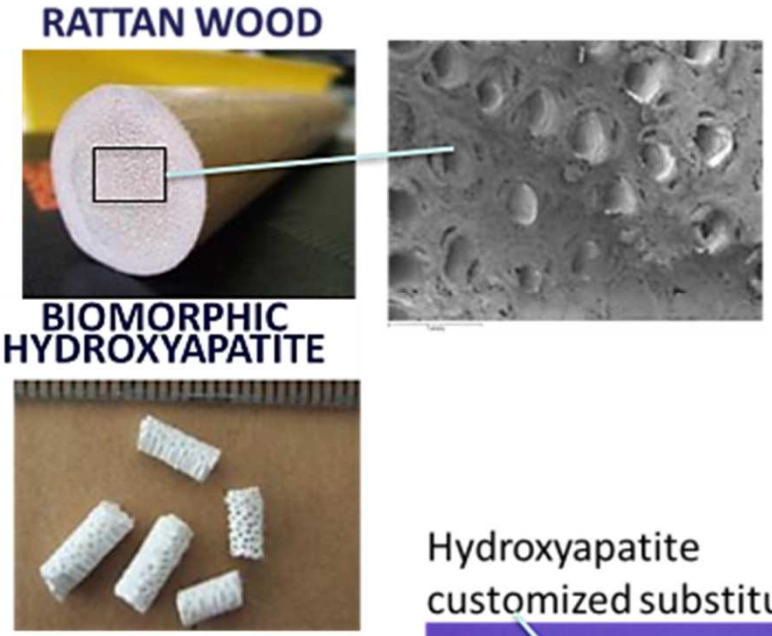


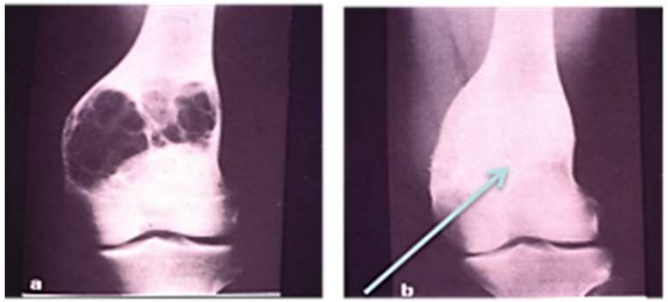




Materials and scaffolds in regenerative medicine

Biomorphic transformation to reproduce the hierarchical structure of bone

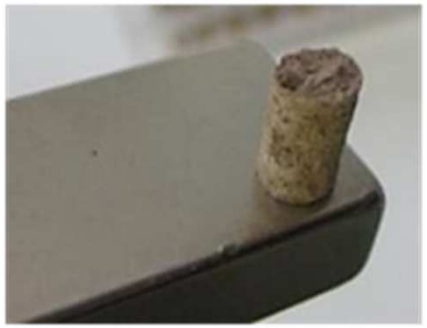




Hydroxyapatite bone substitute

Hydroxyapatite customized substitute bone

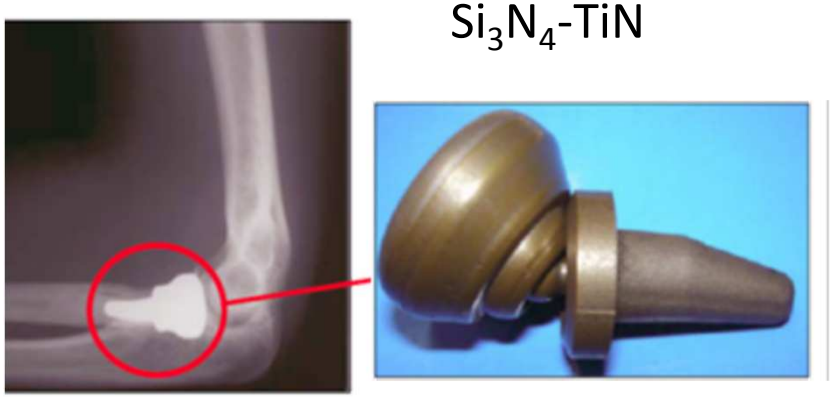
Magnetic scaffolds for bone and osteochondral regeneration

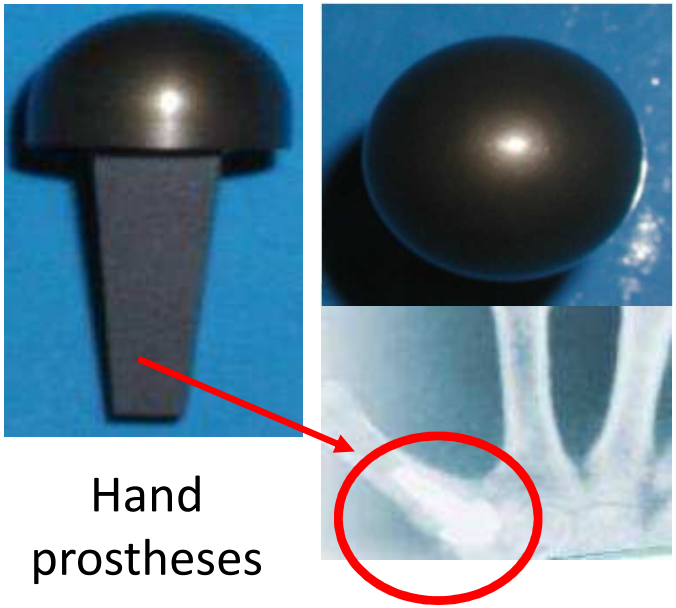


Load-bearing prostheses

Structural prostheses, bio-cements, bio-glasses

Si_3N_4-TiN





Hand prostheses

Knee prostheses

Materials diagnosis

Archaeometric study of ancient ceramics
Definition of manufacturing techniques and origins
Technologies for restoration and conservation

Analysis and restoration of Majolica sculpture, Decorative Terracotta

Characterization and conservation of materials in historical buildings