

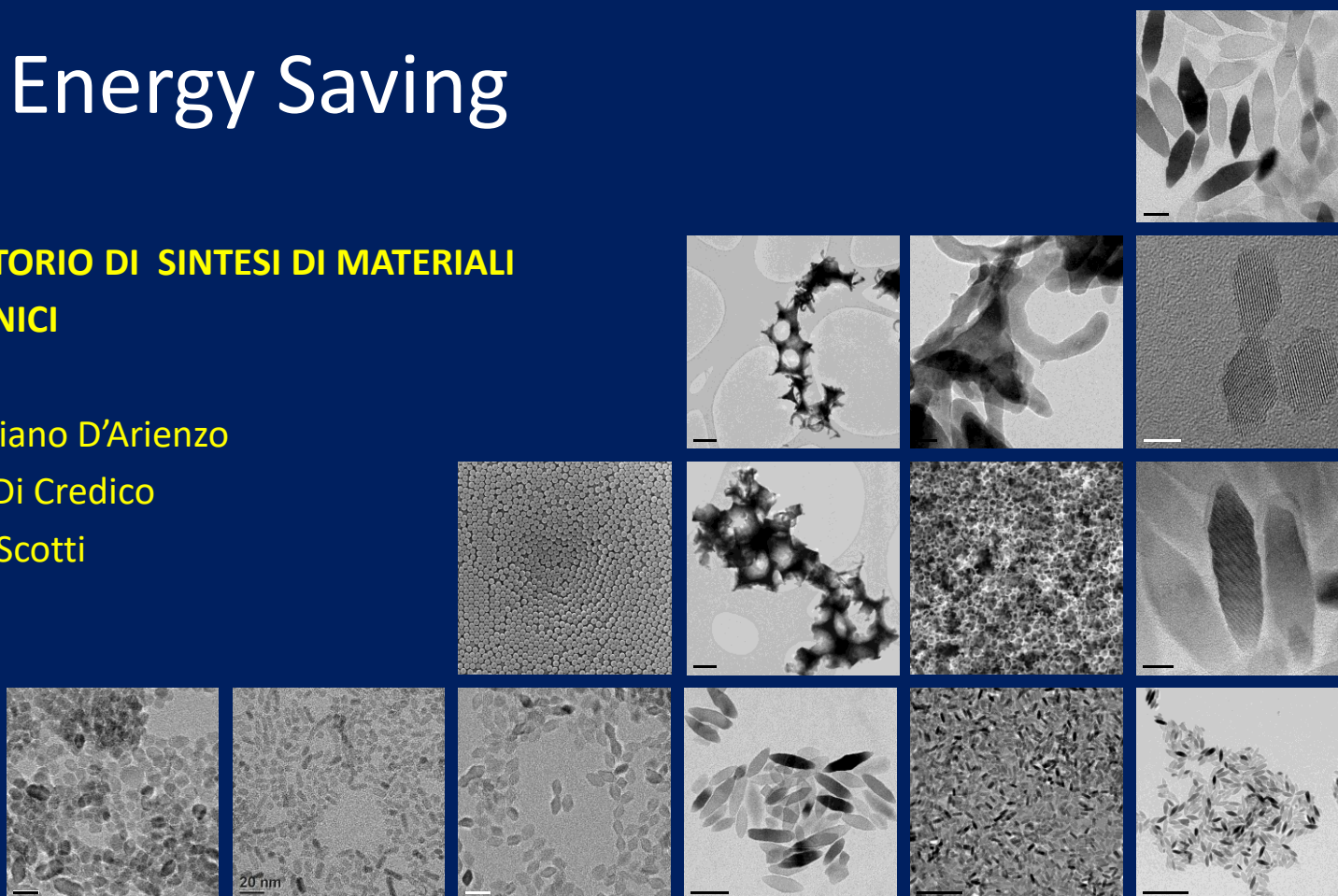
Inorganic and Hybrid Organic-Inorganic Materials for Energy Saving

**LABORATORIO DI SINTESI DI MATERIALI
INORGANICI**

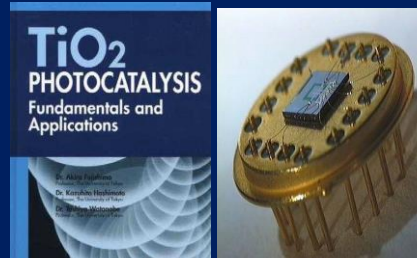
Massimiliano D'Arienzo

Barbara Di Credico

Roberto Scotti



Argomenti di tesi



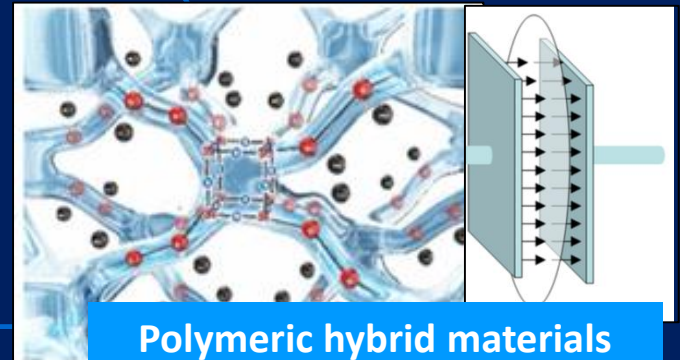
Oxide nanomaterials for photocatalytic applications and gas sensing

**Role of the Structure, Size and Morphology in
Upgrading the Functional Properties and
the Technological applications of Oxide Materials**



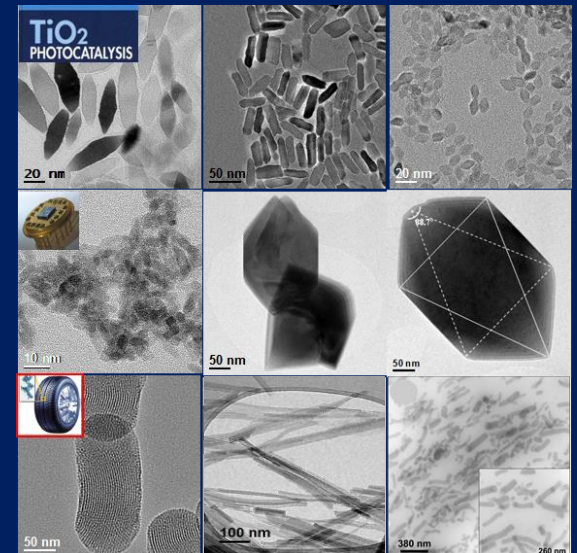
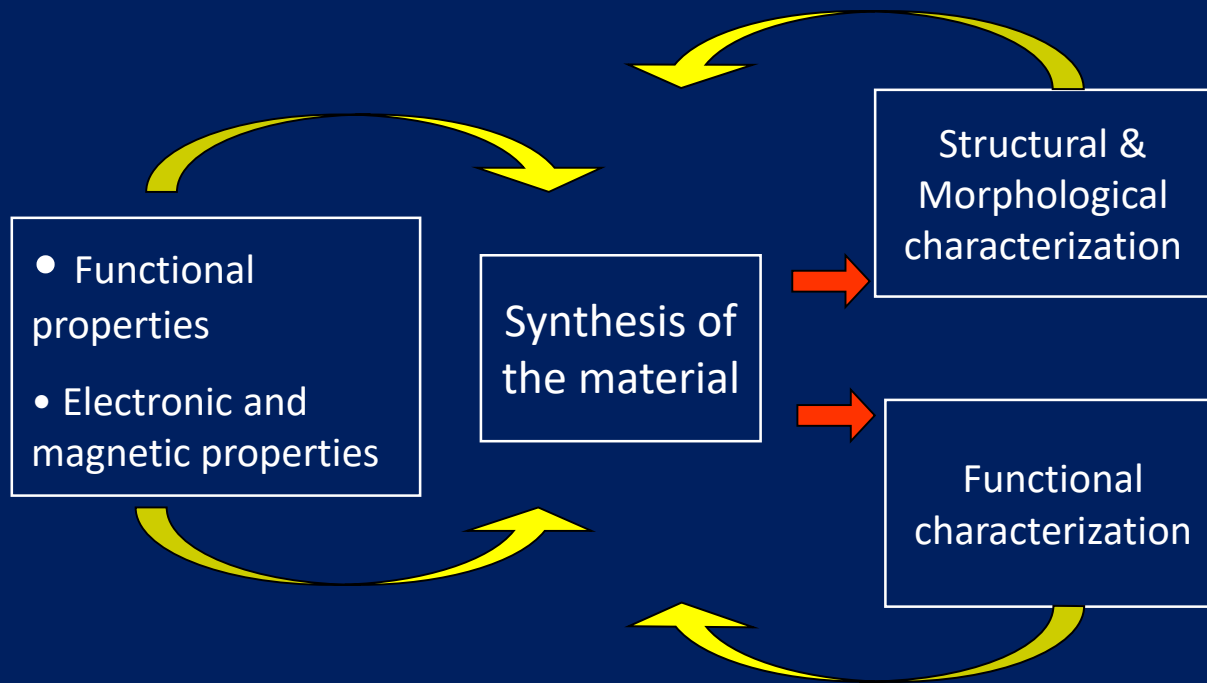
In collaboration with
Pirelli Tyre

New nanofillers for
rubber reinforcement in tires



Polymeric hybrid materials
with dielectric properties

Struttura della tesi

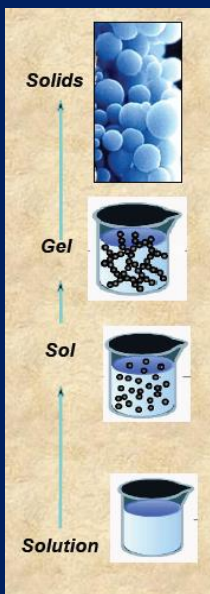


Oxide nanomaterials for Photocatalytic application and sensing

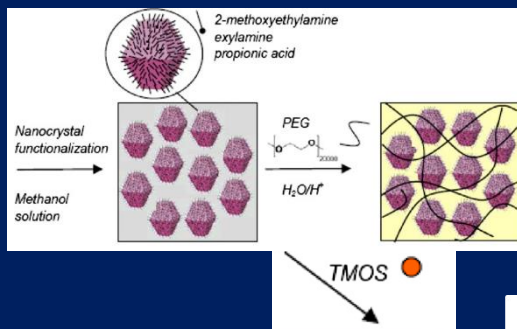
Synthesis



Solvothermal synthesis



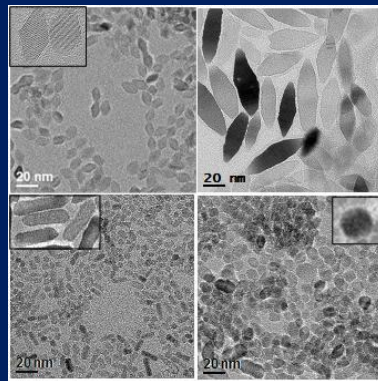
Sol-gel synthesis



Characterizations

XRD diffraction,
SEM & TEM microscopy
Surface area

Shape-controlled TiO₂

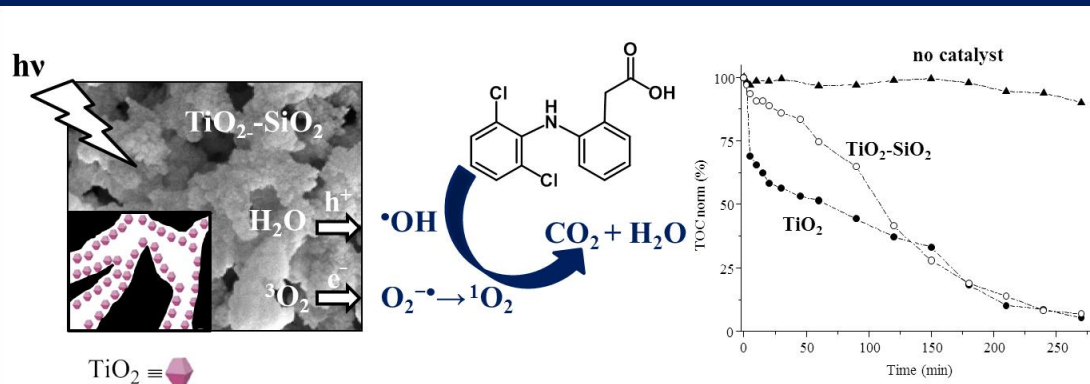


Functional properties & Applications



NO_x abatement in air

Organic pollutant in water



New nanofillers for rubber reinforcement in tires

Synthesis

In-situ and *ex-situ* synthesis (sol-gel, hydrothermal)

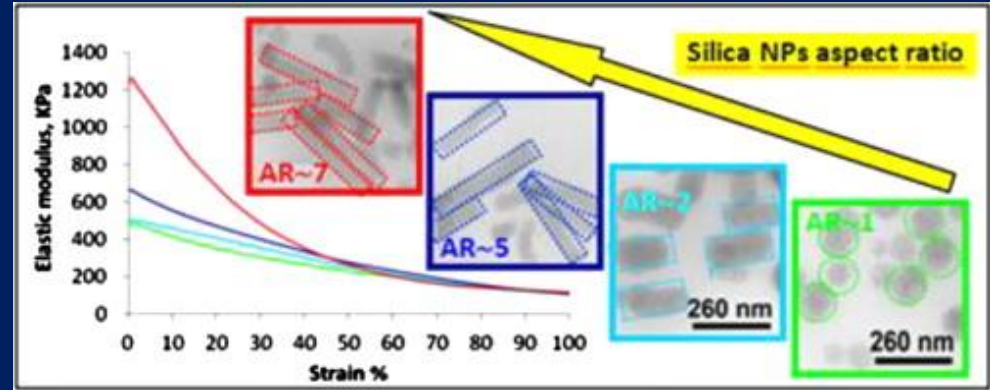
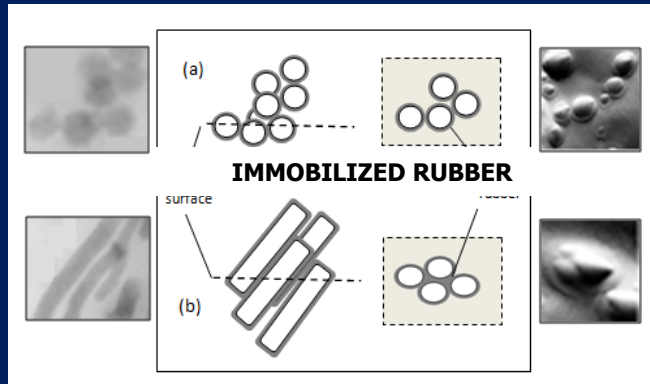
Characterizations

XRD diffraction,
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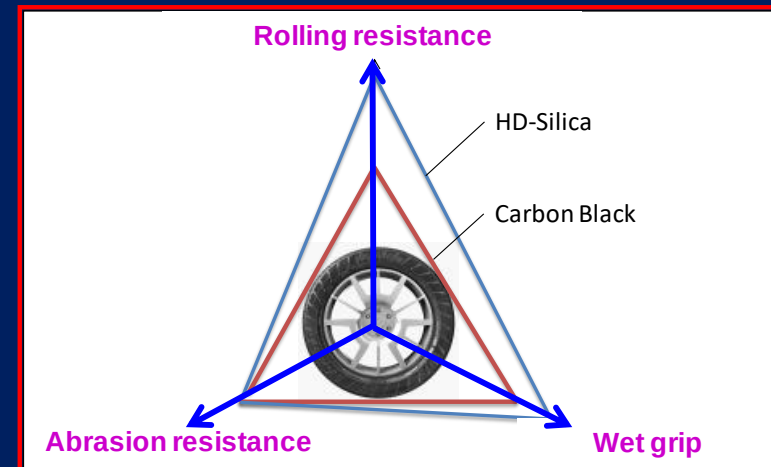
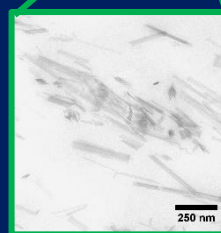
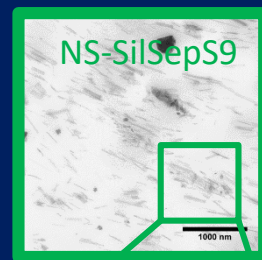
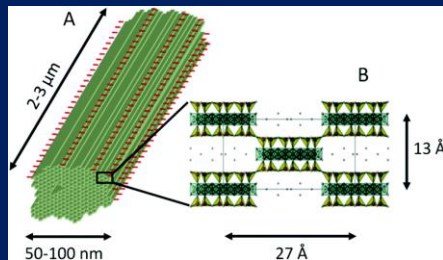
Applications

Stress-strain measurements
Viscoelastic properties

•Synthesis of shape controlled silica NPs as filler for rubber reinforcement



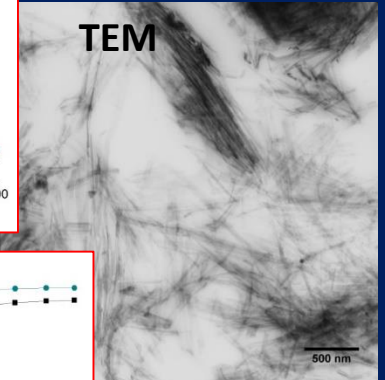
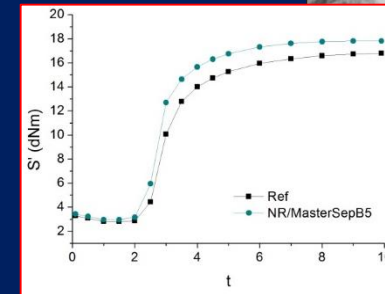
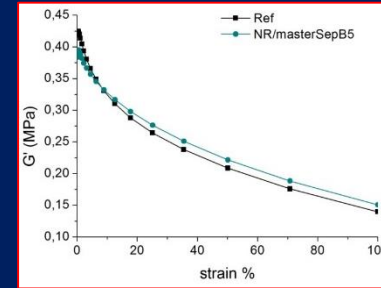
•Anysotropic filler for rubber reinforcement (Phyllosilicates)



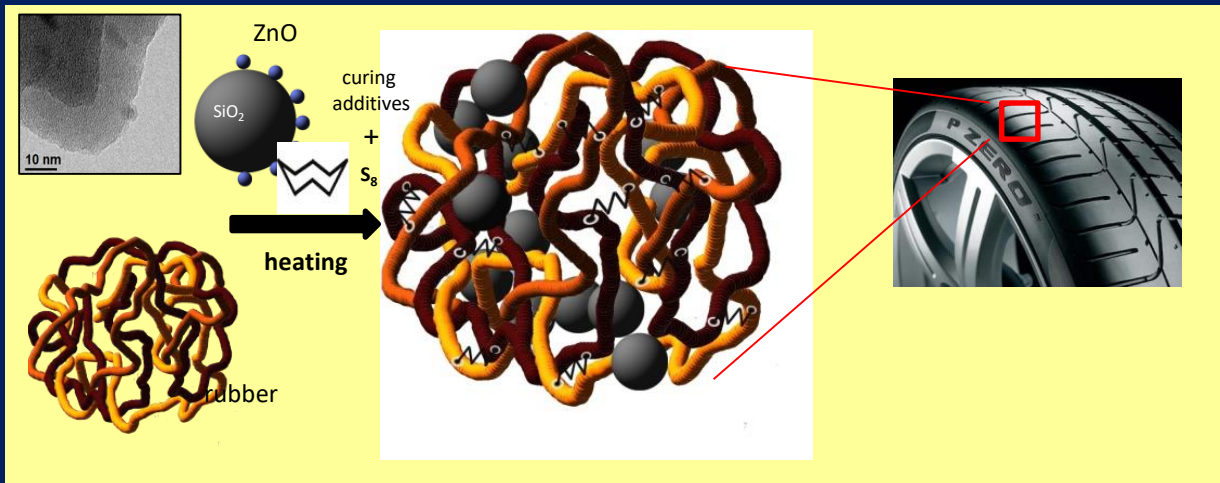
Aim: high-performance rubber composites

•Silica based nanofiller-latex composites for green tyres compounds

Layered silicates in latex natural rubber



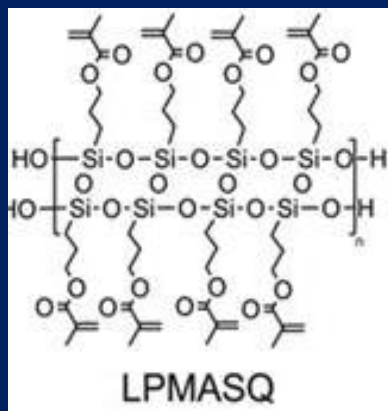
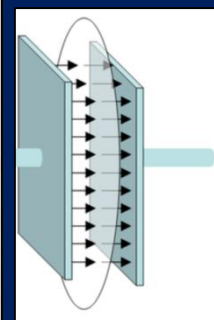
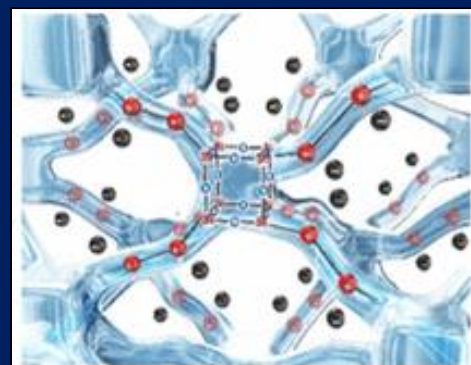
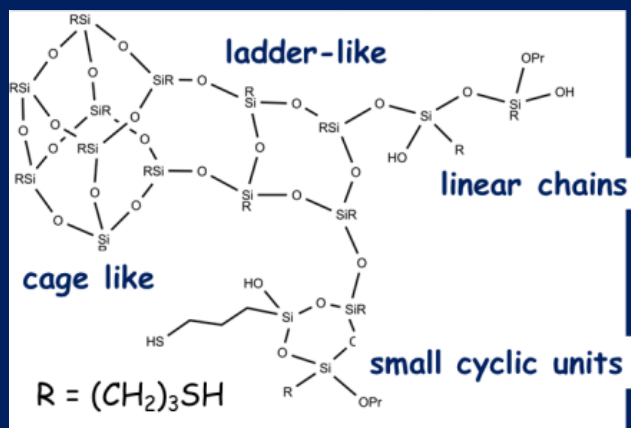
•Synthesis of ZnO decorated silica NPs as activator for rubber vulcanization



Polymeric hybrid materials with dielectric properties

❖ Advanced “molecular” fillers for rubber reinforcement

Nanocomposites enclosing PSQs with controlled cage-like or ladder-like structure and reactive functionalities (thiol or methacryl groups), which enable to modulate both the dielectric and the reinforcement properties of the composites



POSS/ladder-like nanounits with tailored structure and **highly reactive** functional groups (-SH or methacryl)

Other characterization techniques available

Nitrogen Physisorption



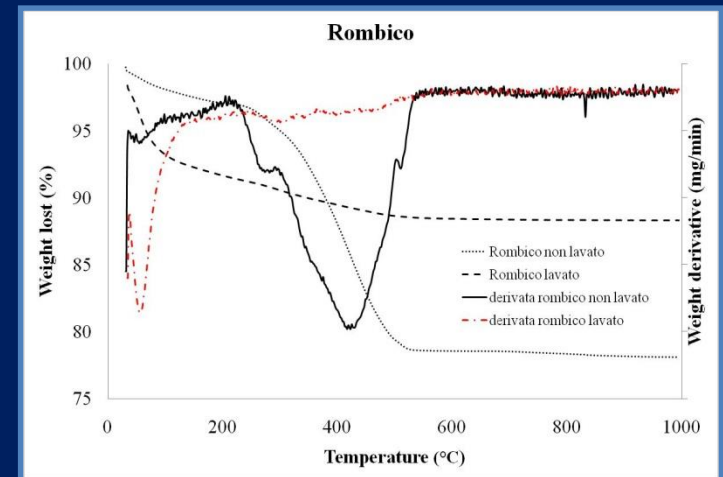
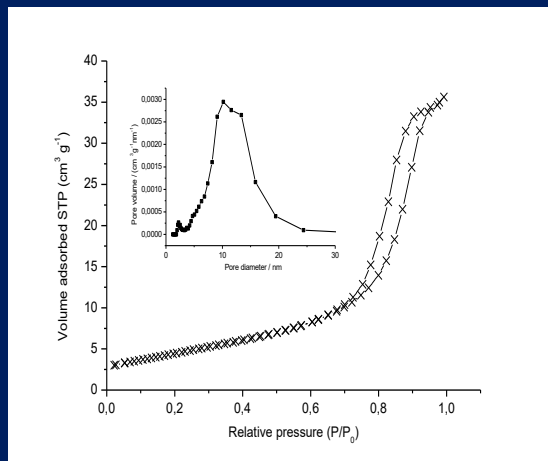
Thermal decomposition and weight loss

TGA-MS



Determination of the specific surface area (BET)

Pore size distribution (BJH)

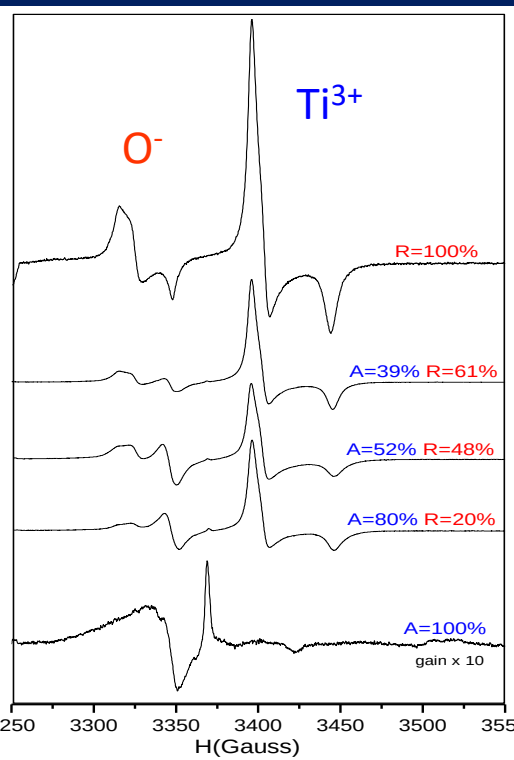


Proprietà elettroniche e magnetiche: Spettroscopia ESR

TiO₂



SnO₂



• The type, abundance and stability of the paramagnetic centers are **relatable** to photocatalytic efficacy and to the sensing properties



Info about catalytic and sensing mechanisms

