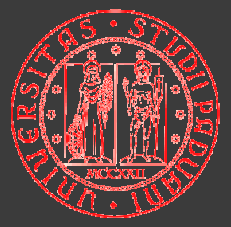
Group name:

IMPACT

Innovative Materials and Processes for Advanced Environmental Clean Technologies



Research activity

Facilities and Skills

Prof. Antonella Glisenti
From left
Michael Pacella
Giovanni Eger
Alberto Garbujo
Andrea Bedon
Giovanni Perin

Contact:
Antonella Glisenti
Dep. Chemical Sciences
University of Padova
Via F. Marzolo, 1
35131 Padova
ITALY
antonella.glisenti@unipd.it
Tel +39 049 8275176
www.chimica.unipd.it/antonella.glisenti

FACILITIES
And SKILLS

Development and optimization of oxide based nano-materials and nanocomposites for a sustainable development

Example of applications:

- New Advanced Electrodes (Mixed Ion Electron Conductive) for Intermediate Temperature Solid Oxide Fuel Cells (SOFCs);
- PGMs free catalysts for advanced applications (Three Way Catalysts, sensors, …)
- Development of sustainable catalysts for clean hydrogen production (alcohols steam reforming and oxidative steam reforming, dry reforming).

Reaction processes are investigated and optimized with ad hoc developed reactors; the main interest is toward sustainable processes:

- CCS (Carbon Capture and Storage)
- Emissions and Pollution control
- Biofuels
- Sustainable hydrogen production

RESEARCH ACTIVITY

Research activity focuses on the investigation of the surface reactivity of nano-oxides and oxide based nanocomposites. The main objective of this research is to develop active materials to be used in heterogeneous catalysis and in devices for a sustainable development.
Particular attention is devoted to the green processes with the aim of developing oxide based materials for a sustainable development.

The research activity mainly concerns the design, synthesis and characterization of oxide based nano-materials and nano-composites (perovskites, transition metal oxides, ...). Nano-materials, synthesised with different procedures, are characterized by means of a multi-technique approach (XPS, XRD, BET, TPR, TPD, UV-Vis, FT-IR, SEM) and their reactivity is investigated.
Both the catalysts and the preparation procedures (wet chemistry methods) are selected taking into consideration the economic and environmental sustainability.

By means of the interaction with probe molecules, the active (acidic/basic and red/ox) sites are investigated and the influence of their distribution and strength is considered with respect to the activity and selectivity in oxidation and reduction reactions (oxidation of alcohols, carbon monoxide and hydrocarbons, reduction of nitrogen oxides, ...).
Objectives: 1) to investigate the reaction mechanisms; 2) to correlate the observed reactivity with the strength and surface distribution of active sites; 3) to evaluate the influence of doping, synthesis parameters, etc. on the activity and selectivity.

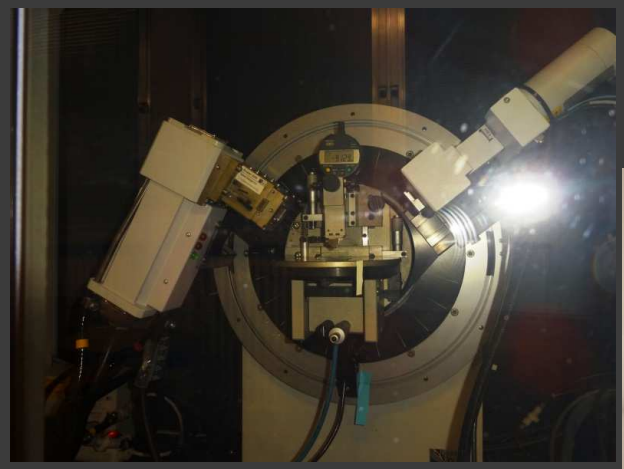
FACILITIES
And SKILLS

The characterization facilities

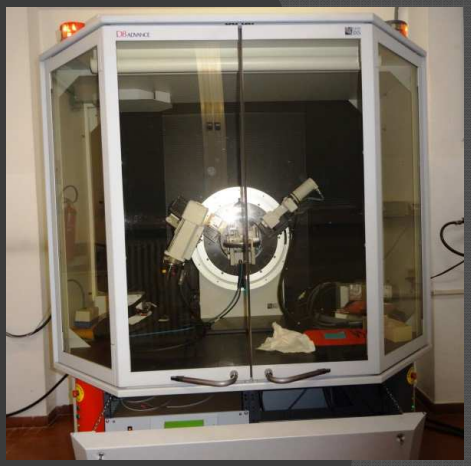
Micromeritics Autochem II 2920

BET, TPR, TPD, O_2-TPD, Outlet connected with a Quadrupole Mass Spectrometer ESS- Genesis

Specific Surface Area
Cations Reducibility
Surface active sites and adsorbed molecules
Oxygen mobility



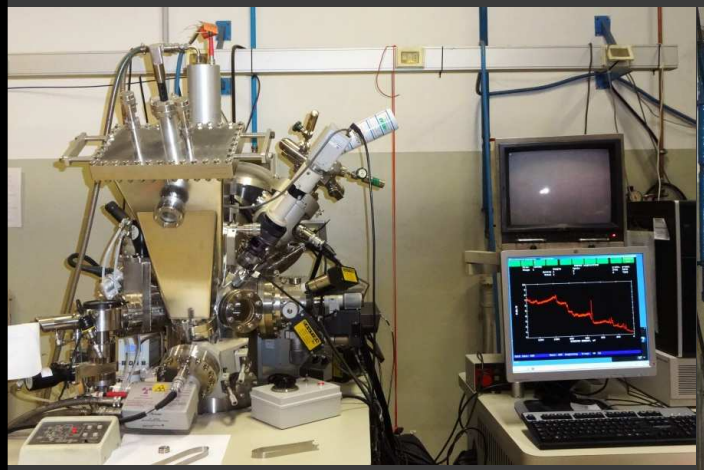
XRD- Bruker D8 Advance

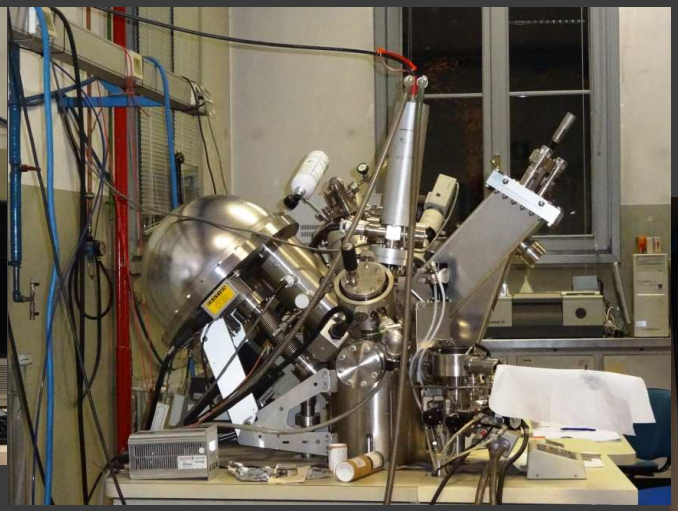


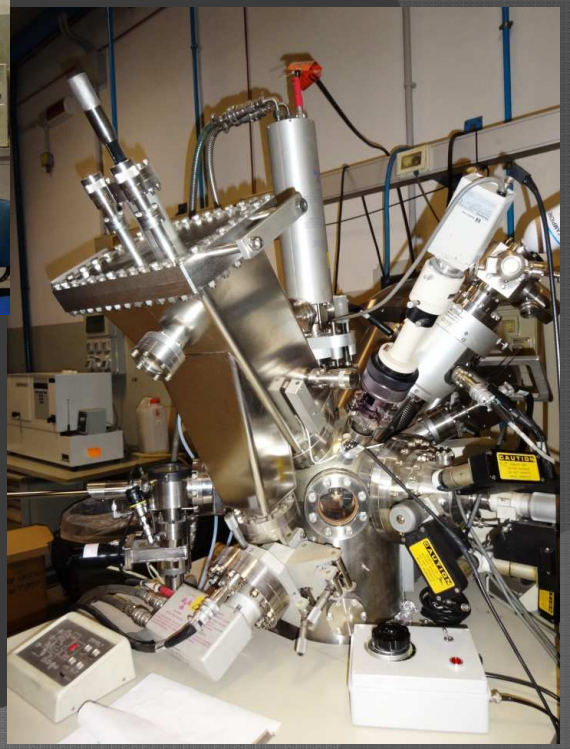
Crystalline Structure Phases
Crystalline size
Purity

FACILITIES
And SKILLS

The surface characterization: XPS







PHI 5600 ci

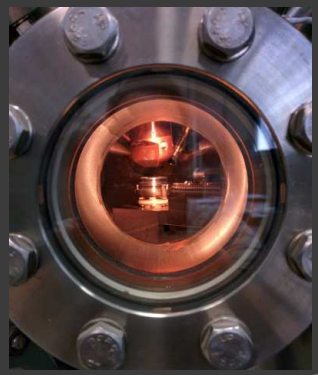
Standard (Al and Mg) and Mono (Al)-source

SURFACE COMPOSITION (nm range):

Elements

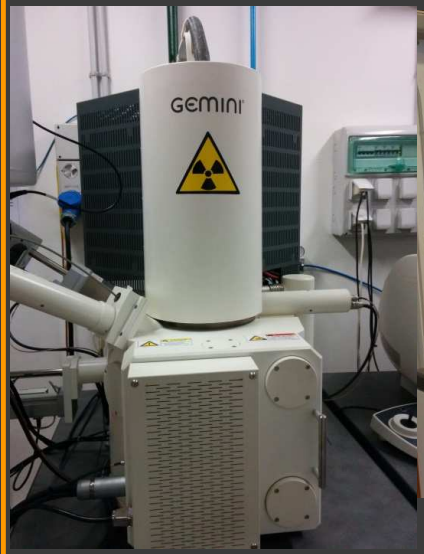
Chemical state of the elements

Atomic percentage



FACILITIES
And SKILLS

The surface characterization: morphology



Supra Zeiss
Scanning Electron Microscope
with EDX, STEM

SURFACE MORPHOLOGY
SURFACE COMPOSITION (µ-range)

Park Scientific
Atomic Force Microscope
5 and 100 µm
scanners

DiSC

FACILITIES
And SKILLS

The surface characterization: active sites

DRIFT - *Diffuse Reflectance Infrared Fourier Transform*

Chamber for chemisorption

FTIR *in operando*

Surface Active Sites Characterization

DRIFT Spectroscopy *in Operando*

- Study of surface functional groups and contaminants (hydroxilation, carbonatation, …)
- Characterization of the active sites (acidic/basic, redox) by chemisorption of probe molecules (CO, NO, Pyridine, …)
- Reaction mechanisms investigation

FACILITIES
And SKILLS

Laboratory for functional characterization: catalytic activity

Quartz reactors connected with GC-MS Agilent 7890 and FTIR Bruker gas cell

Online gas characterization instruments (GC-MS, FTIR) required to measure the gas composition during activity tests; all of them can operate automatically, to carry out dynamic and long-lasting experiments

FACILITIES
And SKILLS

Laboratory for functional characterization: catalytic activity

Reactors with fixed beds
for catalytic activity measurements

- Powders, pellets and structured catalysts (honeycombs) can be tested
- Extensive and versatile set of gas metering lines

used to prepare complex mixture of gases to be fed to the testing reactors and instruments

Packed	Structured	Stagnation	Parallel
Powders	Honeycomb wire mesh	Films	

FACILITIES
And SKILLS

Permeability and conductivity

Permeability chamber

- Oxygen permeability and mobility (membranes, Solid Oxide Fuel Cells – SOFCs)
- Mixed ionic/electronic conduction (MIEC electrodes for SOFCs)