NANOALLOYS
International Research Network

IMN 2018
International Meeting on Nanoalloys

MAY 22-25
Orléans
France

IRCELYON's activities on nanoalloys

Dr. Laurent Piccolo

IRCELYON, 2 Avenue Albert Einstein, 69626 Villeurbanne Cedex, France

piccolo@catalyse.cnrs.fr

Université Claude Bernard Lyon 1
cnrs
Institut de recherches sur la catalyse et l'environnement de Lyon IRCELYON

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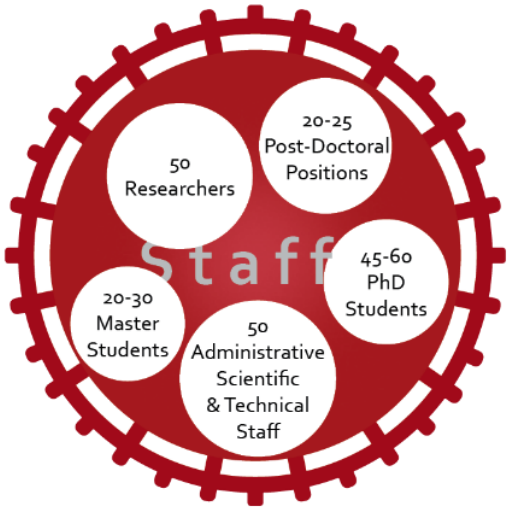


- Catalysis and environmental chemistry
- About 200 people
- 5 research groups
- 8 analytical facilities

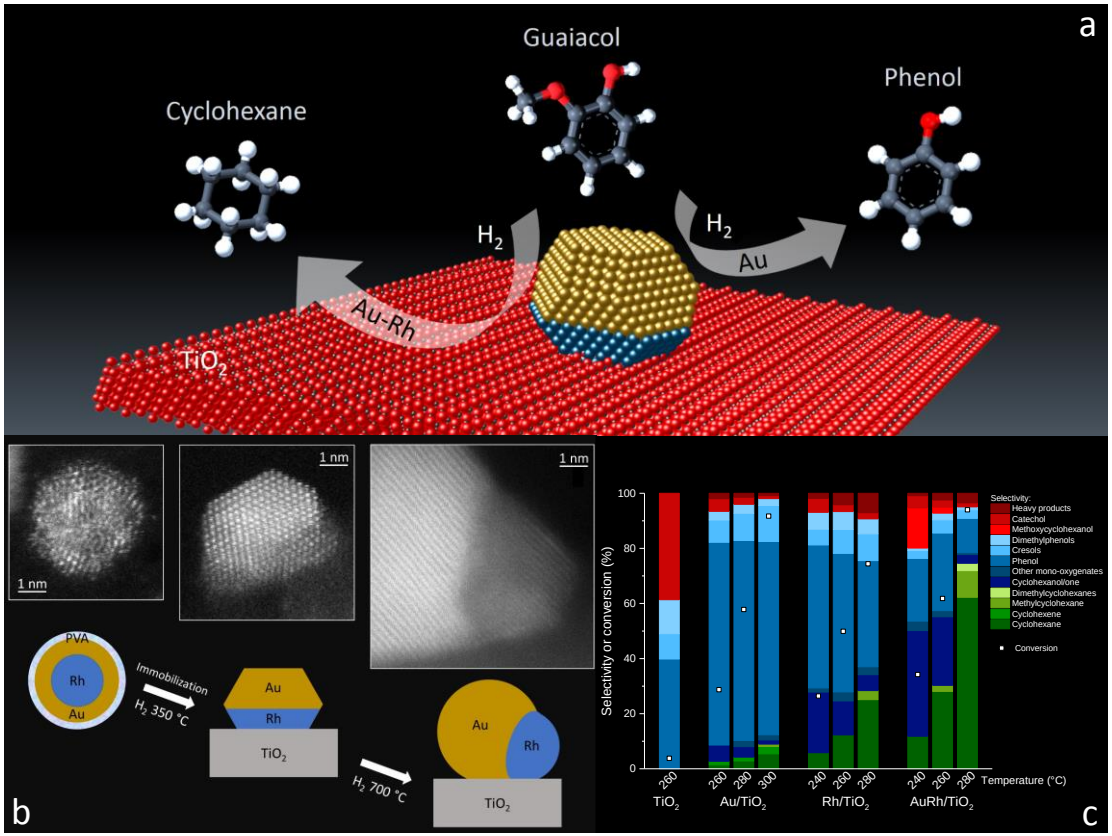
ECI2D (Energy…): Pavel Afanasiev, Gilles Berhault, Christophe Geantet, Laurent Piccolo

Main systems: Ag-In, Au-Pd, Au-Rh & Ir-Pd nanoalloys, Al_4Cu_9 & $Al_{13}Fe_4$ surfaces **(15 papers since 2015)**

Main interests: preparation, structure, sorption (CO, H_2), catalysis (COOX & PROX, hydrocarbon & guaiacol hyd)

Main techniques: STEM, ETEM, FTIR-DRIFTS, XANES-EXAFS, surface science + DFT

see Roy Johnston's talk



Piccolo & coll., *PCCP* **17**, 28112 (2015), *Sci. Rep*. 6, 35226 (2016), *J. Catal.* **344**, 136 (2016), *J. Mater. Chem. A* **5**, 17360 (2017)

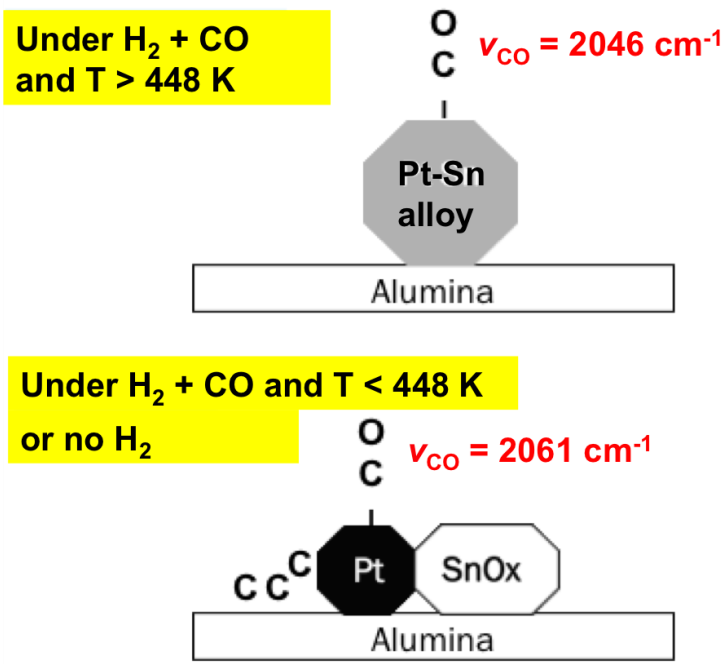
ING (Engineering…): Frédéric Meunier, Franck Morfin, Jean-Luc Rousset, Yves Schuurman

Main systems: Ag-Pd, Au-Ag, Pd-Pt, Pd-Rh, Pd-Sn, Pd-Zn, Pt-Co, Pt-Sn **(8 papers since 2015)**

Main interests: adsorption (CO, NO), catalysis (CO & acetylene hydrogenations)

Main techniques: Infrared spectroscopy, Temporal analysis of products

A novel segregation mode of alloys reveals CO acting as an oxidizer!



Meunier & coll., *J. Catal.* **359**, 76 (2018)

CDFA (Sustainable chemistry…): Michèle Besson, Noémie Perret, Catherine Pinel

Main systems: Au-Pd, Au-Pt, Bi-Pt, Re-Pd, Re-Rh **(7 papers since 2015)**

Main interests: Liquid-phase catalysis (acid hydrogenation, alcohol & glucose oxidations)

Main techniques: XRD, XPS, TEM…

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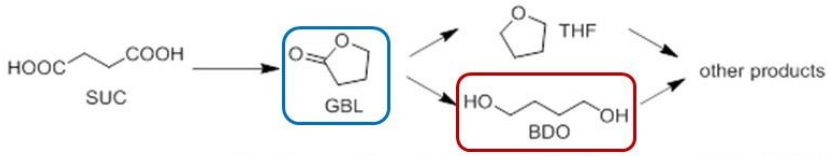
Noémie Perret, Catherine Pinel, Michèle Besson

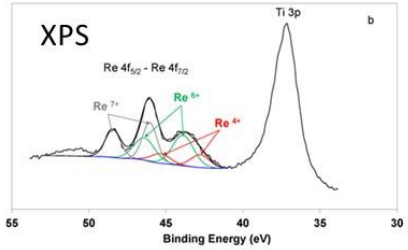
ANR

Aqueous-phase transformation of biosourced molecules (sugars, polyols, carboxylic acids …)
over supported (bi)metallic catalysts

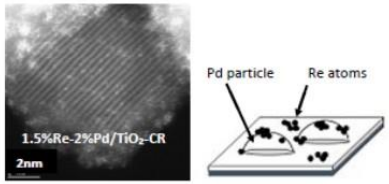
***Example*: Hydrogenation of succinic acid (SUC)**
to γ-butyrolactone (GBL, Pd/TiO_2) or 1,4-butanediol (BDO, ReO_x-Pd/TiO_2)



Reaction conditions: batch reactor, 5 wt% aqueous solution SUC, 160°C, 150 bar H_2



ETEM



B.K. Ly et al, Insights into the oxidation state and location of rhenium in Re-Pd/TiO_2 catalysts for aqueous-phase selective hydrogenation of succinic acid to 1,4-butanediol as a function of Pd and Re deposition methods. *ChemCatChem 7 (2015)* 2161-2178

ATARI (Instrumental approaches…): Francisco J.C.S. Aires, Eric Ehret

Main systems: Au-Pd, Ag-Pd **(4 papers since 2015)**

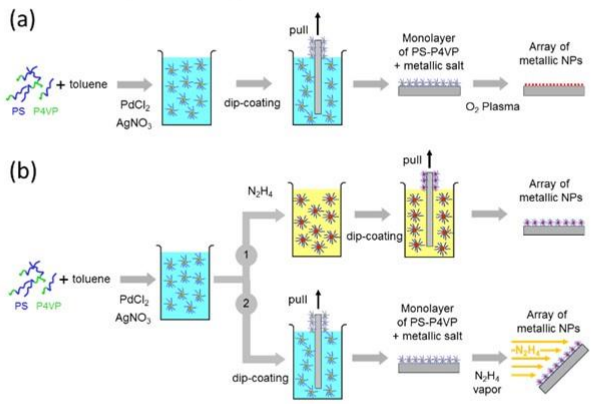
Main interests: synthesis, adsorption (CO), catalysis (acetylene hydrogenation, VOC combustion)

Main techniques: surface science (AFM, XPS…), HRTEM

Nanocatox Project : controllable synthesis of bimetallic nanoparticle arrays for the total oxidation of VOCs

E. Ehret and Francisco J. Cadete Santos Aires
Institut de Recherche sur la Catalyse et l'Environnement de Lyon, UMR 5256 CNRS-Université Lyon 1, 69626 Villeurbanne Cedex, France

Nanoparticle synthesis



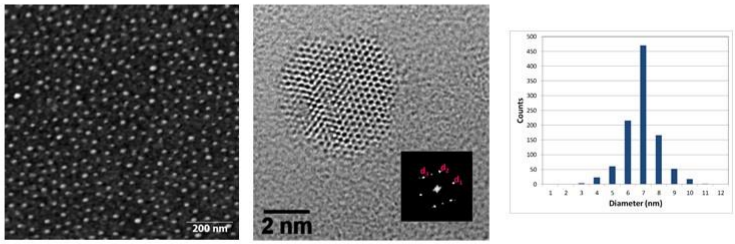
Two methods for the formation of nanoparticles (NPs) after the synthesis of block copolymers (PS-b-P4VP)* : (a) particle formation by O_2 plasma treatment or (b) by N_2H_4 reduction.

* Collaborations with E. Beyou (IMP, UMR 5223 CNRS- Univ. Lyon1)

Nanoparticle array observations

Formation of PdAg nanoparticle ordered array after different steps: polymerization (PS_{410}-b-$P4VP_{62}$), micellization, loading of $PdCl_2$ + $AgNO_3$ salts and O_2 plasma process.

AFM observations | HRTEM observations | Size-histogram



Approach interests

- Highly ordered nanoparticles with tunable composition, size and spacing on various surfaces can be produced.
- Unique opportunity of studying the fundamental properties of model catalysts.