IRCELYON’s activities on nanoalloys

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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, Al₄Cu₉ & Al₁₃Fe₄ surfaces (15 papers since 2015)

**Main interests:** preparation, structure, sorption (CO, H₂), catalysis (COOX & PROX, hydrocarbon & guaiacol hyd)

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

see Roy Johnston’s talk

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!

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...

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/TiO₂) or 1,4-butanediol (BDO, ReOₓ-Pd/TiO₂)

Reaction conditions: batch reactor, 5 wt% aqueous solution SUC, 160°C, 150 bar H₂

B.K. Ly et al, Insights into the oxidation state and location of rhenium in Re-Pd/TiO₂ 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

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**Nanoparticle synthesis**

(a) 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.

(b) 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)

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**Nanoparticle array observations**

AFM observations  HRTEM observations  Size-histogram

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**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.