

FIRST ROW TRANSITION METAL NANOPARTICLES IMMOBILIZED ON UNUSUAL PHASES - A CATALYTIC SURVEY

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Nanocatalysis emerged as a new concept that combines both colloidal catalysis and engineered nano-objects, showing defined structures and composition. Like most metal nanoparticles (MNPs), aggregation during the catalytic reaction can lead to structure modifications, impacting their unique properties and consequently precluding their expected reactivity. A way to avoid these drawbacks is to use solid supports with the purpose of immobilizing the nanocatalysts, favoring their recycling, but adding plausible effects due to metal-support interactions. With the purpose of preserving the surface state, the immobilization of MNPs in a liquid phase has been considered. In addition to environmentally friendly properties, glycerol permits to catch the catalyst and easily extract the organic products thanks to its supramolecular network which favors the dispersion of MNPs; the catalytic phase can be thus recycled, obtaining metal-free target organic compounds [1].

Our team has proved the glycerol ability for the synthesis of both mono- (Pd, Cu and Cu₂O, Ni, Co) and bi-metallic nanoparticles (Pd/Cu), leading to stable colloidal catalytic solutions in the presence of polymers (such as PVP), phosphines and biomass-based stabilizers such as cinchona derivatives [2]. In particular, bimetallic nanoparticles open new horizons in organic transformations, because of cooperative effects between the two partners and structure-reactivity relationships (alloy, core-shell, hetero-dimer...) [3].

In this contribution, an account of our work related to nano-catalysis will be presented mainly focused on first-row transition metal nanoparticles (Co, Ni, Cu), from the synthesis and full characterization of catalytic materials (immobilized in glycerol and naturally occurring solid supports) to catalytic applications, together with some mechanistic insights.

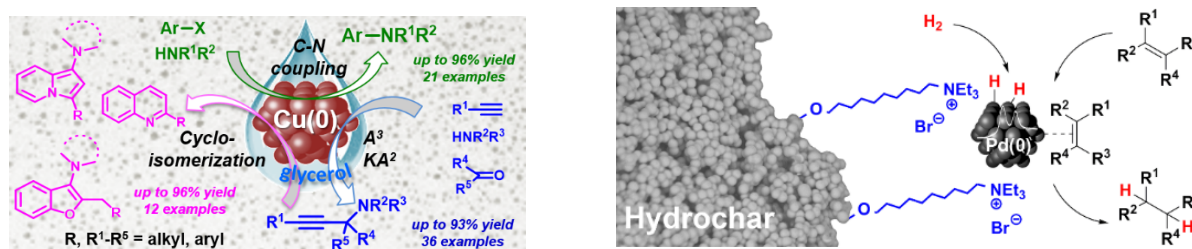


Figure 1. RIGHT: CuNPs dispersed in glycerol applied in tandem processes. LEFT: PdNPs immobilized on functionalized hydrochars applied in hydrogenation reactions.

References

- For selected reviews, see: a) Mamontova, E.; Favier, I.; Pla, D.; Gómez, M., *Adv. Organomet. Chem.* **2022**, *77*, 43-103. b) Camats, M.; Pla, D.; Gómez, M., *Nanoscale* **2021**, *13*, 18817-18838. c) Favier, I.; Pla, D.; Gómez, M., *Chem. Rev.* **2020**, *120*, 1146-1183.
- For some selected contributions, see: a) Pérez, A.; Mauriés, S.; Pla, D.; Gomez, M., *ChemCatChem* **2022**; b) Reina, A.; Favier, I.; Pradel, C.; Gómez, M., *Adv. Synth. Catal.* **2018**, *360*, 3544-3552. c) Favier, I.; Toro, M.-L.; Lecante, P.; Pla, D.; Gómez, M., *Catal. Sci. Technol.* **2018**, *8*, 4766-4773. d) Dang-Bao, T.; Favier, I.; Gómez, *Adv. Synth. Catal.* **2017**, *359*, 2832-2846. e) Chahdoura, F.; Pradel, C.; Gómez, M., *Adv. Synth. Catal.* **2013**, *355*, 3648-3660.
- Dang-Bao, T.; Pradel, C.; Favier, I.; Gómez, M., *ACS Appl. Nano Mater.* **2019**, *2*, 1033-1044.