

Cooperative Activation versus Inhibition for Sustainable Bimetallic Catalysis

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Cooperative Activation versus Inhibition for Sustainable Bimetallic Catalysis

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Cooperative chemistry has become a broad area of intensive research with many prospects for sustainable catalysis. Cooperative approaches capitalize on the fact that synergistic effects between a variety of chemical entities may surpass more traditional catalytic strategies in fundamental aspects as activity, selectivity or substrate scope. Among the many cooperative approaches applied to catalysis, the use of bimetallic structures that rely on the existence of two metals in close proximity, paralleling what is often found in metalloenzymes, has gained considerable attention.[1] This is partly because bimetallic compounds offer a manifold of tunable features that are just not available for mononuclear analogues, as the M–M bond order and polarity, the distance between the metals and the facility to enable multi-site bond activation mechanisms.

In this context, our group has explored a wide variety of bimetallic approaches that go from multiply bonded bimetallic complexes to single and polarized bonds, reaching the extreme case of bimetallic pairs held together by weak or even no interactions in bimetallic Frustrated Lewis Pairs (FLPs).[2] We have analysed the effects of modifying the stereoelectronic properties on the ligands that stabilize both metal fragments to tune the competition between the formation of M–M bonds versus M···M frustration and investigated the reactivity derived from a variety of bimetallic systems.[3] We have learnt that particularly congested bimetallic systems often lead to unexpected reactivity outcomes. This has allowed, for instance, to disclose exotic ligand non-innocence behaviour [4] or propose rather unconventional mechanisms.[5] More recently, we have just realized that the combination of two metallic fragments may not only be exploited to enhance the activity of each of the metals individually, but to move instead into a completely opposite direction, namely to passivate the activity of one metal by the action of another one.[6] This approach, which is widely applied in heterogeneous catalysis, finds very little precedent in molecular systems. Overall, our last results pertaining both cooperative bimetallic activation and cooperative bimetallic inhibition, will be discussed in this contribution.



References

1. a) Buchwalter, P.; Rosé, J.; Braunstein, P. *Chem. Rev.* **2015**, *115*, 28; b) Farley, C. M.; Uyeda, C. *Trends Chem.* **2019**, *1*, 497; c) Campos, J. *Nat. Rev. Chem.* **2020**, *4*, 696.
2. Navarro, M.; Campos, J. *Adv. Organomet. Chem.* **2021**, *75*, 95.
3. See for example: a) Campos, J. *J. Am. Chem. Soc.* **2017**, *139*, 2944; b) Hidalgo, N.; Moreno, J. J.; Pérez-Jiménez, M.; Maya, C.; López-Serrano, J.; Campos, J. *Chem. Eur. J.* **2020**, *26*, 5982.
4. Alférez, M. G.; Hidalgo, N.; Moreno, J. J.; Campos, J. *Angew. Chem. Int. Ed.* **2020**, *59*, 20863.
5. Miranda-Pizarro, J.; Luo, Z.; Moreno, J. J.; Dickie, D. A.; Campos, J.; Gunnoe, T. B. *JACS* **2021**, *143*, 2509
6. Serrano-Díez, E.; Pita-Milleiro, A.; Rangel-García, J.; Moreno, J. J.; Roselló-Merino, M.; Campos, J. *J. Am. Chem. Soc.* **2025**, *147*, 1271.

PERSONAL DETAILS

Family name, First name: **Campos, Jesús**

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Google scholar profile: <https://scholar.google.es/citations?user=2vJR1mEAAA&hl=es>



EDUCATION AND KEY QUALIFICATIONS

09/11/2012 **PhD** University of Sevilla, Department of Inorganic Chemistry (Spain); Prof. Ernesto Carmona

2010 **MSc**, (*Crystallography and Crystallization*), Menéndez Pelayo Int'l Univ., Santander, Spain

2010 **MPhil**, (*Synthetic Organic Chemistry*) University of Manchester, UK; Prof. John D. Sutherland

2007 **Chemistry Degree**, (*1st National Award*) University of Seville, Spain

CURRENT POSITION

2022 - present **CSIC Research Scientist and Group Leader**. CSIC, Institute for Chemical Research.

PREVIOUS POSITIONS

2017 – 2022 **CSIC Tenured Scientist and Group Leader**. CSIC, Institute for Chemical Research.

2016 – 2017 **Marie Curie IF Fellow**. Inorganic Chemistry Department, University of Seville.

2014 – 2016 **Talentia-Marie Curie Postdoc**. University of Oxford, UK. PI: Prof. Simon Aldridge.

2013 – 2014 **Postdoctoral Researcher**. Yale University, USA, PI: Prof. Robert Crabtree

RESEARCH TRACK RECORD

Publications Summary

To date I have 111 scientific articles in international top journals (36 with IF>10) and 4 book chapters, being corresponding author in 57 of them (*Nat. Chem.*, *Nat. Rev. Chem.*, *Nat. Commun.*, *JACS*, *Angew. Chem.*...) and receiving *ca.* 3800 citations.

Selected Awards and Recognitions

2025 Excellence Research Award, Spanish Royal Society of Chemistry

2024 Excellence Research Award, Organometallic Group of the Spanish Royal Society of Chemistry

2024 Fulbright Fellowship: Visiting Professor at the University of Berkeley

2023 Organometallics Distinguished Author Award, (ACS Divisions of Organic and Inorganic Chem)

2021 Lilly Young Researcher Award

2020 Fellow of the Young Academy of Spain (5-year appointment)

Selected Research Grants as Principal Investigator

2025 - 2030 ERC Consolidator Grant. 'BiMetalGAS' (€1,998k)

2025 - 2027 Fundación Ramón Areces Research Projects (€150k)

2023 - 2026 Research Grant. Spanish Ministry of Science and Innovation (€243k + PhD fellowship)

2021 - 2023 5 x Marie Curie Fellowships (as host supervisor), CSIC-Univ. Seville, Spain (overall €972k)

2020 - 2022 PhosAgro/UNESCO/IUPAC research grant in green chemistry (\$30k)

2018 - 2023 ERC Starting Grant. 'CoopCat'. (€1,445k)

2016 - 2017 BBVA Foundation, Leonardo Research Grant (€40k)

Invited Presentations Summary

I have participated in 52 national and international conferences contributing with *plenary talks*, *invited lectures*, and delivered 27 invited seminars across Europe and USA. Selected contributions include SiLQCOM9, 2024, *La Habana (Cuba)*; ICC 45th, 2024, *Fort Collins (USA)*; OMCOS XXI, 2023, *Vancouver (Canada)*; 29th ICOMC, 2022, *Prague (Czech Rep.)*; ACS Fall 2022, *Chicago (USA)*; XXII ISHC, 2022, *Lisbon (Portugal)*. ESOC2019, Vienna (Austria).

Supervision Experience Summary

• 14 PhD students (4 ongoing). *Most graduated students are currently postdoctoral researchers*: N. Hidalgo (Yale Univ.), J. Miranda-Pizarro (Sevilla), M. G. Alférez (Virginia), E. Serrano (CNRS Chimie ParisTech), E. Soto (Bloomington), A. Pita (Oslo), J. Rangel (Guanajuato); *or assistant Professors*: M. Pérez-Jiménez (Univ. Geneva), J. J. Moreno (Univ. Sevilla).

• 12 postdoctoral researchers (Marie Curie (5), Juan de la Cierva (2), Margarita Salas (2) grants). **3 already assistant Prof.**: M. Navarro (Univ. Autónoma Madrid), S. Bajo (Sevilla), F. Cruz-Martínez (Castilla la Mancha), F. León (Sevilla)

• 37 Undergraduate students (6 master; 14 last year undergraduates; 17 foreign visitors (14 as Erasmus+))