## CiQUS Lecture


FONDO EUROPEO DE DESENVOLVEMENTO REXIONAL
PO FEDER Galicia 2014-202 - *Unha maneira de facer Europa*

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*Abstract:*

The ability of the main group element bismuth (Bi) to maneuver between different oxidation states in a catalytic redox cycle will be presented. We will show how Bi mimics the canonical organometallic steps of a transition metal, thus challenging the current dogmas of redox catalysis. A series of Bi complexes capable of revolving between oxidation states Bi(I)/Bi(III) and Bi(III)/Bi(V) have been unlocked and applied in various contexts of catalysis for organic synthesis. For example, capitalizing on the Bi(III)/Bi(V) redox pair, we have developed a catalytic protocol for the C–F and C–OTf bond formation from aryl boronic esters. On the other hand, a low-valent redox manifold based on Bi(I)/Bi(III) enabled the reduction of hydrazines and nitro compounds, the catalytic decomposition of the rather inert nitrous oxide (N2O), the catalytic hydrodefluorination of C(sp2)–F bonds. In addition, we will show how one-electron pathways are also accessible, thus providing a platform for SET processes capitalizing on the triad Bi(I)/Bi(II)/Bi(III) for organic synthesis. Finally, we will also show how redox-neutral catalytic pathways can unlock novel organic transformations via canonical organometallic steps. For all methodologies, a combination of rational ligand design with an in depth analysis of all the catalytic steps proved crucial to unfold the catalytic properties of such an intriguing element of the periodic table.

*Biosketch:*

Josep Cornella (Pep) was born in La Bisbal del Penedès, a small town in south Catalunya. He graduated in chemistry in 2008 from the University of Barcelona and carried MSc studies in the Department of Organic Chemistry studying the chemistry of allylboron reagents.

After completing his masters thesis, he moved to the United Kingdom to pursue doctoral studies in the group of Prof. Igor Larrosa (QMUL). In early 2012, he earned his PhD working on the use of aromatic carboxylic acids as aryl donors in metal-catalyzed decarboxylative reactions. He then moved back to Catalunya, where he joined the group of Prof. Ruben Martin (ICIQ) as a Marie Curie Postdoctoral Fellow. There, he developed novel transformations involving Ni-catalyzed C–O bond activation and carbon dioxide insertion into organic molecules.

In 2015, Pep obtained a Beatriu de Pinós Fellowship to carry out further postdoctoral studies in the group of Prof. Phil S. Baran at The Scripps Research Institute, California, USA. During this time at Scripps, he worked on the discovery and implementation of new transformations based on the concept of “redox-active esters” as practical and readily available partners for Ni- and Fe-catalyzed C–C bond forming reactions.

In spring 2017, he was appointed as a Max Planck Group Leader in the Department of Organometallic Chemistry at the Max-Planck-Institut für Kohlenforschung in Mülheim an der Ruhr, Germany.

In summer of the same year, he obtained a Max Planck Research Group Leader (MPRGL) position in the same Institute, to create and lead the Sustainable Catalysis Laboratory.

# Josep Cornella

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**Academic Career**

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|---|---|
| 10/2017-currently | **Max-Planck Research Group Leader** – Max-Planck-Institut für Kohlenforschung, Germany (Department of Organometallic Chemistry). |
| 04/2017-10/2017 | **Group Leader** – Max-Planck-Institut für Kohlenforschung, Germany (Department of Organometallic Chemistry). |
| 08/2015-03/2017 | **Postdoctoral Research Fellow (Beatriu de Pinós Fellowship)** – The Scripps Research Institute, USA (Prof. Phil S. Baran). |
| 02/2012-04/2015 | **Postdoctoral Research Fellow (Marie Curie – FP7)** – Institute of Chemical Research of Catalonia, Spain (Prof. Ruben Martin). |
| 09/2008-01/2012 | **Ph.D. in Organic Chemistry** – Queen Mary, University of London, UK (Prof. Igor Larrosa). |
| 09/2007-09/2008 | **MSc in Organic Chemistry** – Universitat de Barcelona |
| 09/2003-09/2007 | **BSc Chemistry** – Universitat de Barcelona. |

**Awards and Honours**

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| 2022 | 2022 Padwa Lecture, Columbia University (NY, USA) |
| 2022 | 2022 Merck Organic Chemistry Lecturer, University of Illinois Urbana-Champaign (USA) |
| 2022 | Organometallics Distinguished Author Award 2022 |
| 2021 | Novartis Early Career Award 2021 |
| 2021 | Kyoto Rising Star Lectureship (MSD Life Science Foundation - Japan) |
| 2021 | Heinz Maier-Leibnitz-Preis 2021 (Deutsche Forschungsgemeinschaft) |
| 2020 | ORCHEM Nachwuchspreis 2020 |
| 2020 | Bayer Early Excellence in Science Award 2020 |
| 2020 | Ruhrpreis für Kunst und Wissenschaft 2020 |
| 2020 | Otto Röhm Gedächtnisstiftung Forschung Preis 2020 |
| 2020 | C&EN Talented 12 - Class 2020 |
| 2020 | Dozentenpreis des Fonds (Fonds der Chemischen Industrie) |
| 2020 | Marcial Moreno Award (Royal Spanish Chemical Society-Catalan Section) |
| 2019 | ERC Starting Grant 2020 (European Comission) |
| 2019 | Münster Symposium-CEC Young Researcher Award |
| 2019 | JSP Fellowship (Bürgenstock Conference) |
| 2018 | Thieme Chemistry Journals Award |
| 2017 | Independent Max-Planck Research Group Leader position at the Max-Planck-Institut für Kohlenforschung, Mülheim an der Ruhr, Germany |
| 2015 | Beatriu de Pinos Postdoctoral Fellowship - Generalitat de Catalunya, Spain |
| 2014 | EXPLORA-PROJECT - Ministry of Economia y Competitividad, Spain |
| 2013 | Marie Curie Postdoctoral Fellowship – IEF – FP7 |

**5 Selected Publications from MPI-Kohlenforschung (Independent Career)**

**1.** *Catalytic Synthesis of Phenols with Nitrous Oxide.* Le Vaillant, F.; Mateos Calbet, A.; Gonzalez-Pelayo, S.; Reijerse, E.; Ni, S.; Cornella, J. *Nature* **2022**, *in press.*

**2***. Fluorination of Arylboronic Esters Enabled by Bismuth Redox Catalysis*. Planas, O.; Wang, F.; Leutzsch, M.; Cornella, J. *Science*, **2020**, *367*, 313.

**3.** *Deaminative Chlorination of Aminoheterocycles.* Ghiazza, C.; Faber, T.; Gomez-Palomino, A.; Cornella, J. *Nature Chemistry* **2022**, *14*, 78.

**4.** *An Air-Stable Binary Ni(0)-Olefin Catalyst*. Nattmann, L.; Saeb, R.; Nöthling, N.; Cornella, J. *Nature Catalysis* **2020**, *3*, 6.

**5.** *Catalytic Hydrodefluorination via Oxidative Addition, Ligand Metathesis, and Reductive Elimination at Bi(I)/Bi(III) Centers.* Pang, Y.; Leutzsch, M.; Nöthling, N.; Katzenburg, F.; Cornella, J. *J. Am. Chem. Soc.* **2021***, 143,* 12487.