

Young Career Focus: Dr. Jesús Campos (Spanish National Research Council (CSIC), Sevilla, Spain)

Background and Purpose. SYNFORM regularly meets young up-and-coming researchers who are performing exceptionally well in the arena of organic chemistry and related fields of research, in order to introduce them to the readership. This Young Career Focus presents Dr. Jesús Campos (Spanish National Research Council (CSIC), Sevilla, Spain).

Biographical Sketch



Dr. J. Campos

Jesús Campos was born in Sevilla (Spain), where he studied chemistry (University of Sevilla, 2007, Spain) before moving to the University of Manchester (UK) to work under the guidance of Prof. John D. Sutherland (MPhil, 2008). Upon moving back to Sevilla he joined the group of Prof. Ernesto Carmona to work on fundamental organometallic chemistry, and spent some time as a visiting researcher with Prof. Maurice Brookhart (University of North Carolina, USA, 2010). He returned to the USA later, as a postdoctoral researcher, joining the group of Prof. Robert H. Crabtree at Yale University to work in green catalysis and energy-related transformations (2013–2014). He was awarded a Talentia Postdoc Fellowship for a second postdoctoral period in the laboratory of Prof. Simon Aldridge at the University of Oxford (UK) to focus on bond activation and catalysis with main-group systems (2014–2016). In 2016 he moved back to the University of Sevilla after securing a Marie Curie IF fellowship and one year later he was awarded a permanent position as Tenured Scientist of the Spanish National Research Council (CSIC) to develop his independent career at the Institute of Chemical Research (IIQ) at Sevilla. In 2017 he was awarded an ERC Starting Grant project aiming to develop new strategies in cooperative bond activation and catalysis.

INTERVIEW

SYNFORM *What is the focus of your current research activity?*

Dr. J. Campos Our current interests range over a variety of topics within the fields of organometallic chemistry and homogeneous catalysis. We have recently focused on investigating cooperative chemical systems for small-molecule activation, with the final aim of discovering new catalytic processes. As such, we have embarked into the design of frustrated Lewis pairs based on transition metals, as well as other less well-explored bimetallic combinations of transition metals and low-valent main-group elements. The design of exceptionally bulky ligands for these and other purposes has also become a common aim within our group.

SYNFORM *When did you get interested in synthesis?*

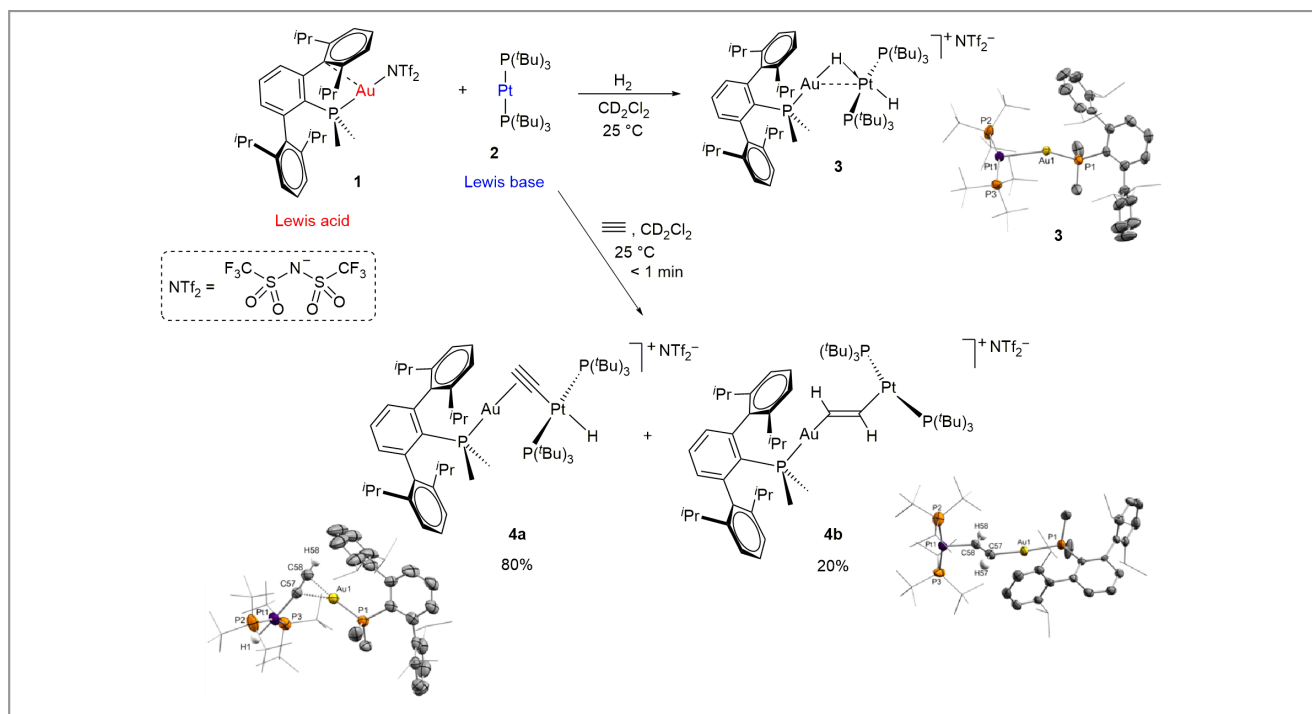
Dr. J. Campos I have been fascinated by synthetic chemistry from as far back as I can remember. I have always been truly enthralled by the creativity of synthetic chemists in preparing complex natural products. Connecting and disconnecting chemical fragments by forming and cleaving chemical bonds to access challenging structures constitutes the perfect blend of art and science. But beyond its beauty, the molecules that synthetic chemists can provide have a tremendous impact on our modern life. My first incursions into synthetic challenges came during my master's studies at the University of Manchester (UK), where I prepared a variety of isotopically labelled nucleosides to carry out mechanistic studies in the context of prebiotic chemistry. A decade later, I retain my interest in the analysis of reaction mechanisms but now focus on the role of metal centers to mediate otherwise unattainable transformations.

SYNFORM What do you think about the modern role and prospects of organic synthesis?

Dr. J. Campos Organic synthesis has been at the heart of modern chemistry for the last century and will certainly remain a key interdisciplinary science for the foreseeable future. Despite being a mature discipline there are still many aspects that require improvement. Chemical sustainability is arguably one of the major challenges for the 21st century. In fact, our chemical industry needs to be more efficient in terms of energy demands, waste production and sustainable feedstocks. The role of organic chemists, particularly those working on developing new catalysts and catalytic processes, will be essential in achieving these goals. Catalysis already occupies a prominent position in synthetic organic chemistry, both at laboratory scale and in industry, and looking at how Nature does chemistry, I am convinced of the many groundbreaking discoveries in the field of catalysis that will emerge in the years to come, not only applied to organic synthesis, but also to other related areas such as materials science or supramolecular chemistry.

SYNFORM Could you tell us more about your group's areas of research and your aims?

Dr. J. Campos As mentioned before, our current interests include many aspects of organometallic chemistry and homogeneous catalysis, with particular emphasis on developing cooperative systems based on underexplored concepts. I have the privilege of working with a group of several highly motivated students that certainly enjoy doing science. This allows us to consider not only our initial aims, but also every other aspect that shows up in the course of our investigations. Besides all the nice surprises that we find in these excursions, we are particularly focused on developing several types of cooperative chemical systems for small-molecule activation and, eventually, for their application in the development of new catalytic transformations. The first of these involves the design of frustrated Lewis pairs (FLPs) based on transition metals. The ability of FLPs to activate a wide variety of small molecules has revolutionized the chemistry of the P block elements, which are now capable of mediating bond-activation reactions that were thought to be restricted to transition metals. Catalytic applications of FLPs mainly include hydrogenation and other related transformations. However, the introduction of transition metals into FLP designs can enhance



Scheme 1 Small-molecule activation by a gold(I)/platinum(0) metal-only FLP

the catalytic potential of the FLP concept by virtue of the set of elementary reactions that transition metals offer. We expect that metallic FLPs will expand the catalytic usefulness of the concept far beyond their current applications. Our efforts in the field allowed us to describe the first metallic FLP in which the two components of the cooperative pair are based on transition metals, more precisely Au(I) and Pt(0) as the Lewis acid and basic components, respectively (Scheme 1). This pair readily reacts with dihydrogen or acetylene in a cooperative manner, while the individual metallic components exhibit either no or dissimilar reactivity. We are now extending these results to other late-transition metals and exploring their potential in cooperative catalysis.

In a related line of research that we started very recently, we are pursuing the design of hybrid systems that incorporate a low-valent main-group element and a transition-metal center in close proximity. We expect that the ability of the former to activate a wide variety of polar bonds, along with the chemical richness of the latter, will permit the discovery of new ways of bond activation and catalysis. In addition, we have lately begun to explore other bimetallic and multimetallic systems that operate under synergistic mechanisms for the activation of small molecules. A common aspect shared by the three lines of research described is ligand design, particularly those that provide sufficient steric protection to modulate the balance between metal–metal interaction and frustration and to kinetically stabilize unsaturated species.

SYNFORM *What is your most important scientific achievement to date and why?*

Dr. J. Campos Our team started as an independent research group very recently and thus our most important scientific contributions are yet to come. That being said, I am most proud of my first report in the field of transition-metal FLPs, which I developed myself and published two years ago as a single-author paper (*J. Am. Chem. Soc.* **2017**, *139*, 2944–2947). This work laid the foundation for one of our most productive research lines at the moment and, I would like to believe, it will motivate other research groups to develop these types of cooperative systems and exploit their potential in catalysis.

