Young Career Focus: Dr. Mariola Tortosa (Universidad Autónoma de Madrid, 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. Mariola Tortosa (Universidad Autónoma de Madrid, Spain).

Biographical Sketch

Dr. M. Tortosa

Mariola Tortosa obtained her B.S. in chemistry from the Universidad Autónoma de Madrid (UAM, Spain) in 1999. She then joined the group of Dr. R. Fernández de la Pradilla at the Instituto de Química Orgánica General (CSIC, Madrid, Spain) to carry out her graduate work on the development of new asymmetric methods using chiral sulfoxides. In 2004, she received the Lilly Award for PhD students. In 2005, she moved to The Scripps Research Institute in Florida (USA) to work as a postdoctoral fellow with Professor William Roush. Her research in Florida was directed toward completion of the total synthesis of the antitumor agent Superstolide A using a transannular Diels–Alder strategy. In 2008, she returned to the Instituto de Química Orgánica General in Madrid as a Juan de la Cierva fellow. In 2011, she started her independent research at the Universidad Autónoma de Madrid (Spain) with a Ramón y Cajal contract. More recently, she received an ERC Starting Grant awarded by the European Research Council to work on the project 'Design and Applications of Unconventional Borylation Reactions'. Her research interests include boron chemistry, asymmetric catalysis and the synthesis of natural products. She received the Young Investigator Award from the Royal Society of Chemistry of Spain (2014), the Young Spanish Investigator Eli Lilly Award (2014) and the Thieme Chemistry Journals Award for young professors (2015).

INTERVIEW

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

Dr. M. Tortosa Our interests range from the development of new metal-catalyzed reactions to the total synthesis of natural products. Recently, we have been focused on the chemistry of boronic esters to accomplish these goals. Inspired by unsolved problems found in the synthesis of bioactive molecules, we have searched for unconventional ways to activate boron compounds to efficiently prepare valuable synthetic intermediates.

SYNFORM *When did you get interested in synthesis?*

Dr. M. Tortosa I became interested as an undergraduate during my first course in organic chemistry. Although I enjoyed most chemistry classes, I fell in love with the power of organic synthesis to build complex molecules. I loved the idea of being able to be artistic and make molecules that could benefit society at the same time. Later on, my PhD and postdoctoral mentors played a critical role in growing and refining my interests in the field.

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

Dr. M. Tortosa Over the last 60 years there has been enormous progress in the field of synthesis. However, there is still a need to develop more efficient and more sustainable synthetic methods. One of our key commitments as organic chemists is the challenge of improving sustainability. For this goal, catalysis will continue to play an essential role to address, making reactions more selective, increasing process efficiency and reducing waste.

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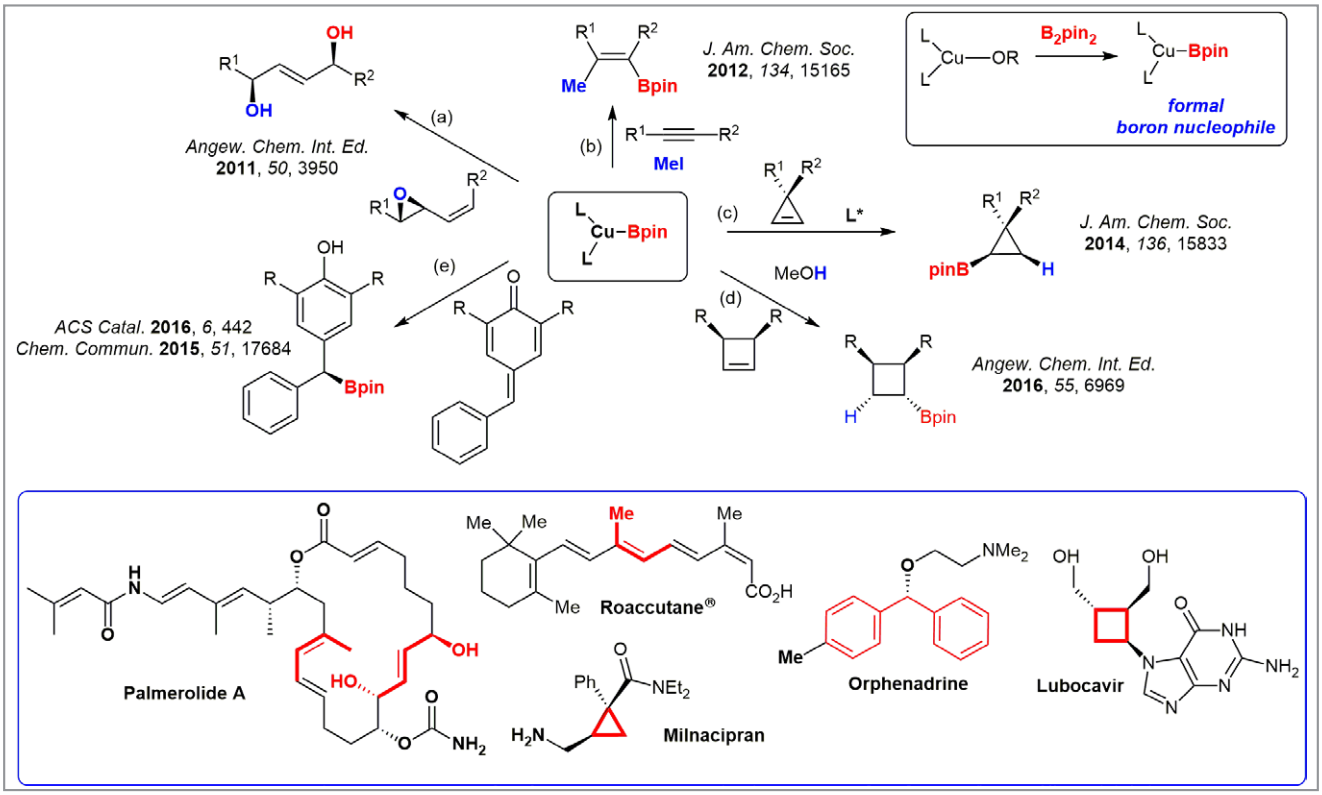
In a broader sense, I believe chemistry, and in particular organic chemistry, remains vital for science and society. We are increasingly witnessing a blend between scientific disciplines, and organic chemistry skills will be crucial for interdisciplinary research. For example, organic chemists will play a critical role in understanding molecular recognition and binding in drug discovery or in the use of self-assembly techniques in nanotechnology.

SYNFORM *Your research group is active in the areas of metal catalysis, natural products and stereoselective synthesis. Could you tell us more about your research and its aims?*

Dr. M. Tortosa As mentioned above, we have focused on the chemistry of boronic esters to accomplish these goals. Boronic esters are versatile synthetic intermediates for the preparation of a wide range of organic molecules. Traditionally, the methods for forming carbon–boron bonds have mostly been based on the electrophilic nature of boron due to its empty p-orbital. While this classical approach works very well for reactions that involve a nucleophilic partner, it necessarily limits the type of boron-containing molecules that can be synthesized. Changing the electrophilic nature of boron, by developing methods to generate and use nucleophilic boron species, would open new ways to introduce boron atoms into organic molecules. This concept has been the driving force of my research during the first stage of my career as an independent researcher. Inspired by unsolved problems found in the synthesis of bioactive molecules, we have searched for unconventional ways to activate boron compounds to efficiently prepare valuable synthetic intermediates. One of our primary tools has been the use of catalytic amounts of copper to generate nucleophilic boron species in situ from commercially available compounds. The lower price and toxicity of copper versus other transition metals and the unique reactivity of the boryl–copper intermediates make these processes particularly attractive. We have invested particular effort in the synthesis of chiral molecules containing sp3 carbon–boron stereocenters, which are difficult to access by known methods. Using this strategy, we have successfully developed new stereoselective methods for the preparation of fragments that are present in bioactive natural products or drugs such as 1,4-diols, trisubstituted alkenes, diaryl methanes and functionalized small rings. Palmerolide A, Roaccutane®, orphenadrine, milnacipran



Scheme 1

and lubocavir are examples of bioactive molecules that have inspired the development of these synthetic methods.

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

Dr. M. Tortosa Perhaps the two projects I am most proud of are my first two publications as a corresponding author. The first project that I developed without the assistance of a single student dealt with the stereoselective synthesis of 1,4-diol fragments via a copper-catalyzed borylation reaction. These results were published in *Angew. Chem. Int. Ed.* **2011**, *50*, 3950 as a solo author publication and paved the way for my current research. I consider this project as the true starting point of my independent career. The second one dealt with the copper-catalyzed carboboration of alkynes (*J. Am. Chem. Soc.* **2012**, *134*, 15165). I think this contribution opened a new and efficient way to prepare functionalized alkenes. Both publications were crucial to apply for an ERC Starting Grant, which gave me a unique opportunity to build my own research group.