Young Career Focus: Prof. Dr. Ivan Vilotijević (Friedrich Schiller University Jena, Germany)

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 Prof. Dr. Ivan Vilotijević (Friedrich Schiller University Jena, Germany).

Biographical Sketch

Prof. Dr. I. Vilotijević

Ivan Vilotijević was born and raised in Serbia. He studied chemistry at the University of Belgrade (Serbia), Ohio State University (USA) and the University of Illinois at Urbana-Champaign (USA), and learned the ropes of scientific research with Prof. Leo Paquette and Prof. David Gin. He earned his Ph.D. in organic chemistry from Massachusetts Institute of Technology (USA) in 2010 where he developed *endo*-selective epoxide-opening cascade reactions for the synthesis of ladder polyether natural products with Prof. Tim Jamison. He then moved to Max Planck Institute of Colloids and Interfaces (Germany) as a Marie Curie postdoctoral fellow with a focus on synthesis, biological and biophysical studies of complex GPI glycolipids in the Biomolecular Systems department led by Prof. Peter Seeberger. In 2015 he joined the faculty at Friedrich Schiller University Jena (Germany) as an assistant professor where his group works on the design, discovery, and development of novel (catalytic) methods for synthesis of organic molecules.

INTERVIEW

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

Prof. Dr. I. Vilotijević We focus on discovering new and improving the existing patterns of reactivity of organic molecules and use this as a foundation for the development of transformations that will meet the needs of the modern society in biomedical fields, address the environmental challenges related to energy and sustainability and push the limits of what is possible in organic synthesis. The main research activities in the group are in the areas of Lewis base catalysis and organophosphorus chemistry. These core projects are grounded in the fundamental aspects of organic chemistry and guided by sheer scientific curiosity, but they are often inspired and directed by the needs of medicinal chemistry, pharmaceutical, and biomedical research.

SYNFORM *When did you get interested in synthesis?*

Prof. Dr. I. Vilotijević I have always had an inclination towards natural sciences and I realized early on that chemistry, as the central natural science, was the one that satisfies my natural curiosity the most (and easily connects to all other natural sciences). My decision to become a chemist evolved during participation in the programs at Petnica Science Center, a unique independent institution for extracurricular, formal and informal, science education of high school students. As an undergraduate student, I was drawn to synthesis because of its proactive nature and the opportunity it gives to create, change and manipulate molecules. Working as an undergraduate research intern at OSU and UIUC introduced me to research in organic synthesis and set me on a path to becoming a synthetic organic chemist. Throughout my time as a graduate student at MIT and a postdoc at Max Planck Institute, I remained determined to pursue an independent academic

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career as a synthetic chemist. During this time, I have worked on projects close to biological and biophysical fields, which only strengthened my conviction that organic synthesis will remain an integral part of any interdisciplinary effort in chemical sciences.

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

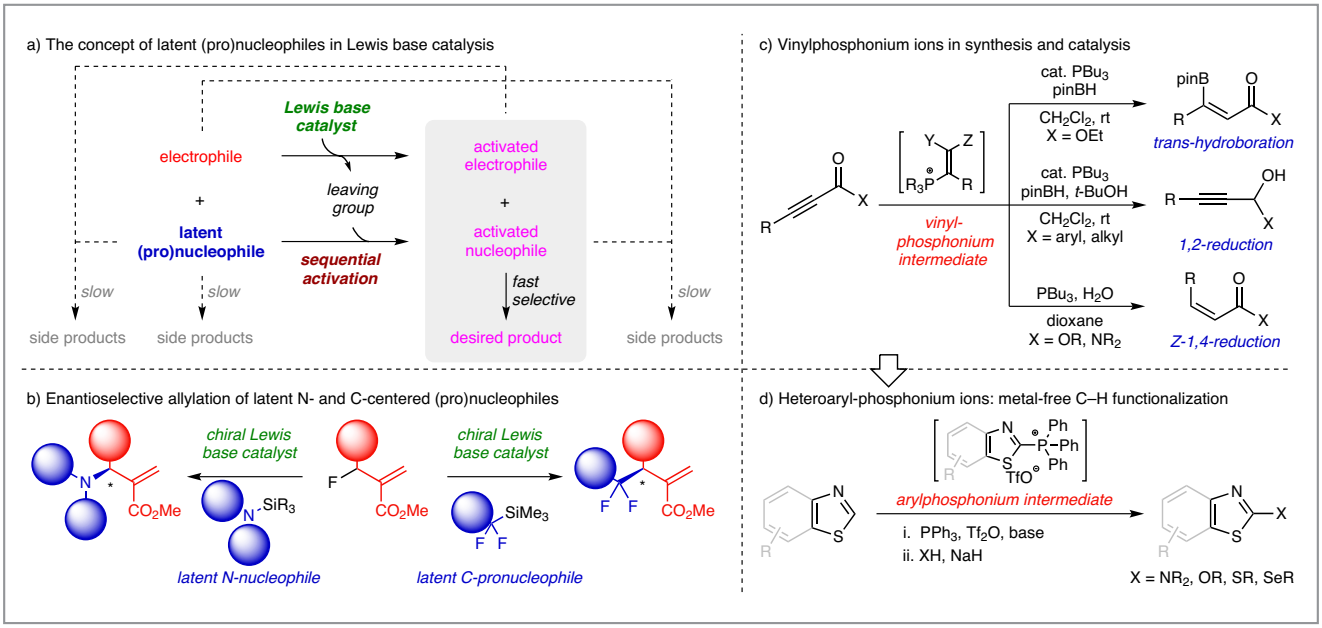
Prof. Dr. I. Vilotijević The more you know, the more you know you don't know. This easily applies to organic synthesis. I am sure that many synthetic chemists will agree with the previous statement, but organic chemistry as a mature field must communicate this to other disciplines to debunk the common "anything can be made easily" attitude. For those in the field, a better interpretation of this statement is "the more you know, the more questions you ask" and that means that there is plenty of progress to be made in the field. These questions can be adequately answered by fundamental research and I personally hope for a renaissance of basic organic chemistry research that will provide long-term benefits for the society. Only in this light will organic chemistry remain a leading discipline of scientific research.

In applied organic synthesis, it is easy to see the ever-increasing need for more diverse and more complex organic molecules in virtually all branches of industry and research which is why organic synthesis is here to stay. The real question is who will do organic synthesis in the future and how will it be done. I believe that we need to embrace new technologies like automation and artificial intelligence and use them as tools to solve scientific problems and gain further knowledge. The more diversity we have in the technical set-ups we use, the better! Finally, the environmental impact of organic synthesis and its sustainability will be central in any future synthetic efforts at scale.

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

Prof. Dr. I. Vilotijević We are committed to discovering new patterns of reactivity that will enable practical and more sustainable synthetic methods. Most of our efforts are in organocatalysis and in making bridges between main group chemistry and organic synthesis. Our focus on studying the underexplored/underutilized intermediates in Lewis base catalysis led our current research in two general directions: Lewis base catalysis and organophosphorus chemistry. In both fields, our approach is similar and based on a detailed analysis and understanding of the reaction mechanisms and the reactivity of intermediates.

In the field of Lewis base catalysis, we have established the concept of latent nucleophiles where we start the reaction with capped molecules of diminished nucleophilicity and require the interdependent sequential activation of the



Scheme 1 The work of Vilotijević group in Lewis base catalysis and organophosphorus chemistry

electrophile and the nucleophile (Scheme 1, a).[1] Our studies have shown that this concept allows for a much broader scope and improved selectivities in Lewis base catalyzed enantioselective allylations (Scheme 1, b).[2] Furthermore, we are exploring the reactivity of non-traditional frustrated Lewis pairs in the context of Lewis base catalysis. In this area, we have developed hydroboration and reduction protocols that involve vinylphosphonium intermediates (Scheme 1, c).[3] Moving from the vinyl- to arylphosphonium ions has resulted in the development of the C–H functionalization protocols which are the basis of the broader transition-metal-free platform for functionalization and cross-coupling of N-heterocycles (Scheme 1, d).[4] In the area of organophosphorus chemistry, we also focus on P(III)–P(V) cycling and the development of new phosphorus-containing functional materials and fluorophores.[5] Lastly, we have a strong connection to biological research and collaborative projects where our chemistry is used in the synthesis of natural products, biosynthetic intermediates and other bioactive molecules and probes for biological research.

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

Prof. Dr. I. Vilotijević My group is very excited about the concept of latent (pro)nucleophiles which we have recently outlined and used to address the specific challenges in enantioselective Lewis base catalysis. Not only does this concept enable expanded scope for Lewis base catalyzed reactions, but it may also lead to improvements in other fields of catalysis in general and be applicable to transition-metal-catalyzed reactions. With that said, I like to think that our most important scientific achievements are still ahead of us.

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