

Young Career Focus: Prof. Guillaume Berionni (University of Namur, Belgium)

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. Guillaume Berionni (University of Namur, Belgium).

Biographical Sketch



Prof. G. Berionni

Guillaume Berionni received his PhD in 2010 from the University of Versailles, France. He then moved to the Ludwig Maximilian University of Munich (Germany) as a Humboldt postdoctoral fellow, and became independent PI researcher under the guidance of Prof. H. Mayr and Prof. P. Knochel. Since 2018, he has been professor of chemistry at the University of Namur, Belgium. His research interests are organo-boron chemistry, main-group compounds, and organometallic reactivity. He is actively involved in teaching, especially at the Master's level.

INTERVIEW

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

Prof. G. Berionni My group's research interests range over a variety of topics within the fields of organometallic, main-group and physical organic chemistry (www.unamur.be/en/sci/chemistry/rco). Our current research focuses on the development of structurally unique nitrogen- and phosphorus-containing Lewis bases and new carbon- and boron-containing Lewis acids. We investigate their reactivity and properties, and then combine them in pairs with molecular linkers for creating new bifunctional acid–base catalysts. Creating new chemical entities based on main-group elements to mimic the rich and multifaceted chemistry of transition-metal complexes is an exciting challenge and requires a combination of state-of-the-art synthetic and computational chemistry.

SYNFORM *When did you get interested in synthesis?*

Prof. G. Berionni My interest in organic and organometallic synthesis began during my research activities throughout my chemistry studies in various universities in the area of Paris (France). I worked at the Universities of Paris-South-Saclay, Paris-Est (with Prof. Gosmini), Sorbonne – Pierre and Marie Curie University (Prof. Thorimbert and Prof. Malacria) and Paris-Cergy (Prof. Cahiez). All the researchers I met were fascinated by organometallic synthesis and reactions mechanisms. In the last year of my Master's studies, I published my first research communication (*Synlett* **2007**, *18*, 2829–2832), and it motivated me to start a PhD at the University of Versailles (Prof. Goumont and Prof. Terrier).

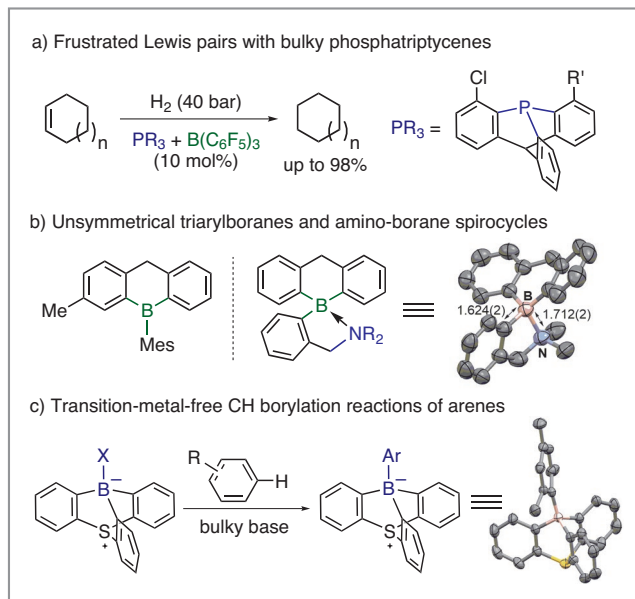
SYNFORM What do you think about the modern role and prospects of organic synthesis?

Prof. G. Berionni Organic synthesis, or the art of activating and selectively transforming chemical bonds and making new molecules is, and always will be, fundamental for the development of new chemical processes and materials. While reactions mediated by transition-metal catalysts have been known for more than a century, the last two decades witnessed spectacular developments in the emerging area of catalysis mediated by non-metallic species (organocatalysis, main-group catalysis, frustrated Lewis pairs catalysis, and photocatalysis).

Thus, I believe that in ten years from now, catalysts containing *s*- and *p*-block elements will transform the area of activation of strong covalent bonds (C–H, C–F, C–C) and will inspire chemists to develop more sustainable and cost-effective catalytic processes. Also, the quantification of the reactivity of organic and organometallic compounds will guide the efforts of synthetic chemists and allow them to explore uncharted catalysis space more quickly by building structure–reactivity models displaying predictive power.

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

Prof. G. Berionni Our group's research is principally focused on the synthesis and investigation of the reactivities of new carbon- and boron-containing acids, and of new sterically hindered bases (amines and phosphines). We subsequently combine these reactive entities to design transition-metal-free catalysts for hydrogenation reactions, C–H bond borylations, and other challenging reactions with small molecules. The main strategy for engineering new main-group catalysts, which we have been pursuing for a number of years, relies on



Scheme 1 Selected examples of ongoing research projects

the uses of polyaromatic linkers (anthracene, triptycene) to design unprecedented acid–base bifunctional catalysts with finely adjustable geometries and stereo-electronic properties (Scheme 1).

We are combining advanced theoretical quantum chemical approaches, spectroscopic methods (NMR, stopped-flow spectrophotometers) and synthetic methods (pressure reactors, Schlenk lines, glove-boxes) throughout our work (Figure 1). Our long-term goal is the reprogramming of the reactivity of main-group compounds (from group XIII and XIV) by exploiting original concepts (pyramidal Lewis acids, low-reorganization-energy catalysts, curved linkers) towards new transition-metal-free catalyst development strategies.

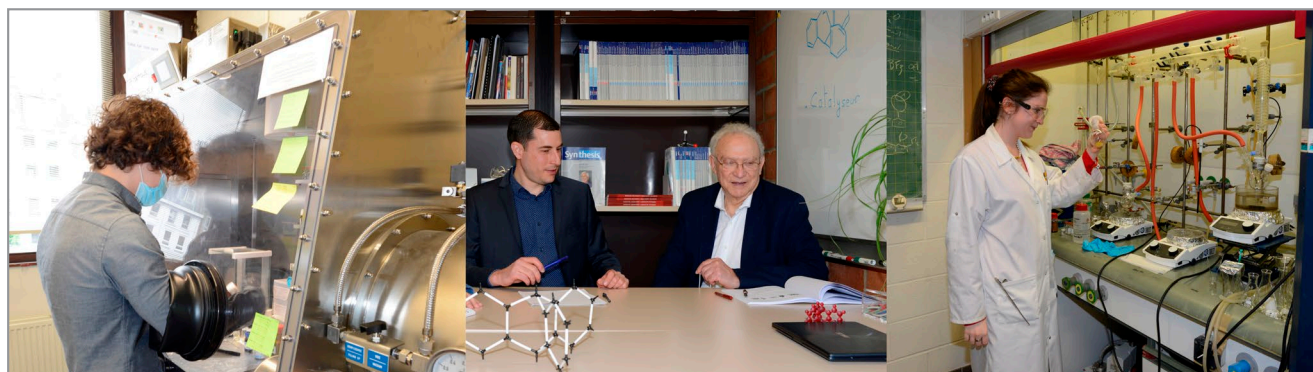


Figure 1 Researchers Arnaud Osi (left) and Jennifer Theissen (right) working at the organic chemistry labs and office meeting with Prof. Alain Krief (center). Photographs by Jean-Paul Dujoux.

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

Prof. G. Berionni My most important scientific achievement is the recent synthesis of the long-sought 9-boratriptycene Lewis acid (*Angew. Chem. Int. Ed.* **2020**, *59*, 12402). This nonplanar boron Lewis acid (Figure 2a) has puzzled several research groups for half a century and is one of the most pyramidal boron Lewis acids ever generated in solution (*Synlett* **2020**, *31*, 1639–1648). We also successfully developed a 9-bora-10-sulfonium-triptycene and a 9-bora-10-phospha-triptycene (Figure 2b) with a dual reactivity mode from Lewis acid to superacid via protonation/deprotonation of the phosphorus atom (*Angew. Chem. Int. Ed.* **2019**, *58*, 16889).

These achievements laid the foundation for one of our most productive research lines, and other unprecedented boron Lewis acids are currently being developed in our laboratories. I hope that we and other research groups will exploit the potential of these new classes of boron Lewis superacids in catalysis in the future.

Matteo Fenu

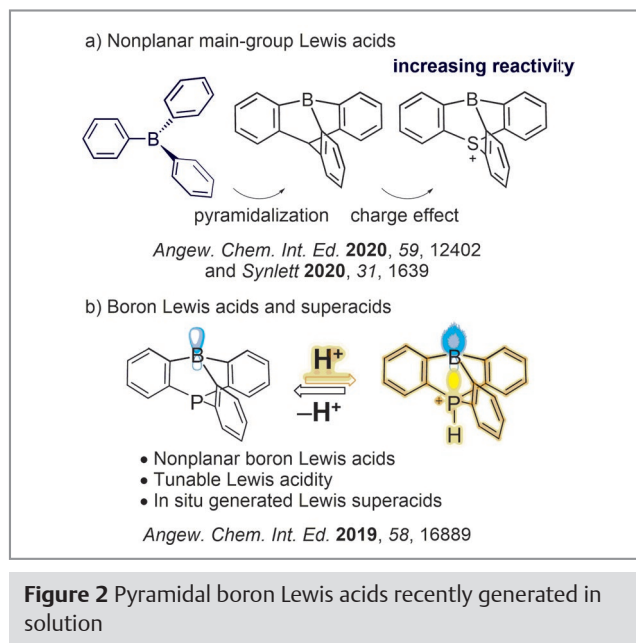


Figure 2 Pyramidal boron Lewis acids recently generated in solution