

Young Career Focus: Prof. Quentin Michaudel (Texas A&M University, USA)

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. Quentin Michaudel (Texas A&M University, USA).

Biographical Sketch



Prof. Q. Michaudel

Quentin Michaudel received his B.Sc. (2008) and M.Sc. (2010) from the École Normale Supérieure de Lyon (France). He then earned his Ph.D. (2015) under the guidance of Professor Phil S. Baran at The Scripps Research Institute (USA), where he explored C–H functionalization methods and their applications to the synthesis of complex molecules. Upon graduation, Quentin began a postdoctoral appointment at Cornell University (USA), working with Professor Brett P. Fors on the development of photocontrolled polymerizations and the design of biorenewable monomers. In 2018, Quentin started his independent career as an assistant professor at Texas A&M University (USA) in the Department of Chemistry and, as of 2019, is also affiliated with the Department of Materials Science and Engineering. His research focuses on the development of synthetic methods to access polymers with unique architectures and properties, as well as bioactive molecules and π -conjugated materials. Olefin metathesis, click reactions, benzyne chemistry, and photochemical transformations are but a few reaction manifolds currently explored in his group. He was the recipient of the Thieme Chemistry Journals Award in 2021.

INTERVIEW

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

Prof. Q. Michaudel Currently, my group's interests center on the implementation of modern organic reactions to synthesize unprecedented polymeric architectures, as well as complex molecules in general. For example, we are designing reactions for the selective functionalization of bioactive molecules and the synthesis of polymers via Sulfur(VI) Fluoride Exchange (SuFEx) click chemistry. Of particular interest is the exploration of the chemistry of sulfamides and polysulfamides with an emphasis on harnessing their hydrogen-bond behaviors for a variety of applications. Another focus is the study of polymerization processes based on stereoretentive olefin metathesis as a means to access new conjugated polymers with an eye toward the production of materials for energy storage and production (e.g., batteries, photovoltaic devices). Finally, we are interested in the invention of green chemical transformations via photocatalysis or electrochemistry, and the development of sustainable polymers that can be depolymerized after use.

SYNFORM *When did you get interested in synthesis?*

Prof. Q. Michaudel I became interested in chemistry at an early age, but my love for synthesis really started as a student at the École Normale Supérieure de Lyon (France). During my master's studies, I had the opportunity to spend six months in the laboratory of Prof Phil Baran at The Scripps Research Institute (USA) as a visiting student, which cemented my desire to pursue a career in organic synthesis. During this internship, I was tasked with the development of a stereoselective synthesis of the active metabolite of the antiplatelet medication clopidogrel (Plavix™), which is one of the most commonly prescribed drugs in the world. The exact stereochemistry of this unstable metabolite was unknown at the

time. This project was a collaborative effort with the pharmaceutical Bristol–Myers Squibb and together, we were able to develop three complementary routes to the different metabolites of clopidogrel.¹ This experience was transformative in many ways. It was the longest synthetic sequence I had ever worked on (13 linear steps) and I had to learn how to work with minute amounts of compounds to optimize each step. More importantly, my knowledge of organic synthesis drastically improved through the discussions with my advisor, the guidance of the postdoctoral researcher mentoring me, and the intellectually stimulating atmosphere of the Baran laboratory. It was also the first time that my academic interest for synthesis coincided with solving a “real life” problem. Following my PhD at Scripps, I joined the group of Prof. Brett Fors at Cornell University (USA) to expand my chemistry horizons. There, I utilized my synthetic expertise and my knowledge of radical mechanisms to design new polymerization processes with the help of talented co-workers. My training in both organic chemistry and polymer synthesis provides me with a unique opportunity to lead an independent research group at the interface of both fields.

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

Prof. Q. Michaudel Organic synthesis is a very mature field of research and discovering new modes of reactivity has become increasingly challenging. However, the potential of organic synthesis to unlock disruptive technologies and world-changing inventions has never been as apparent, nor as exciting. From modern medicine to agrochemicals; plastic packaging to tires and coatings; and solar cells to CO₂ capture, organic synthesis has delivered – and will continue to provide – the molecules and materials that sustain and improve our way of life. With the modern arsenal of organic reactions, the practitioner is limited only by their imagination in designing new molecules with unique functions and behaviors. This wealth of methods will continue to drive discoveries, not only in chemistry, but also in adjacent fields such as biology, physics, materials science, and beyond.

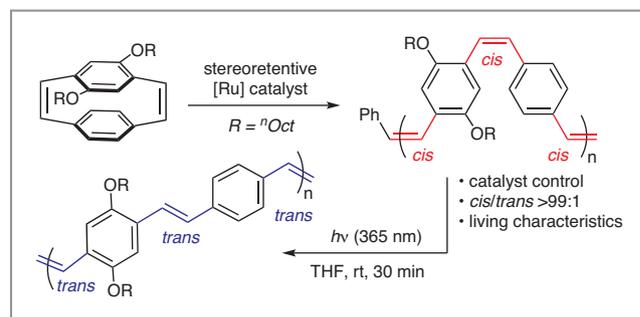
SYNFORM *Could you tell us more about your group's areas of research and your aims?*

Prof. Q. Michaudel As previously mentioned, my group works at the interface of organic chemistry and polymer science. Broadly speaking, we are trying to push the boundaries of polymer synthesis via the design of new monomers and the invention of unique methods of polymerization. Once

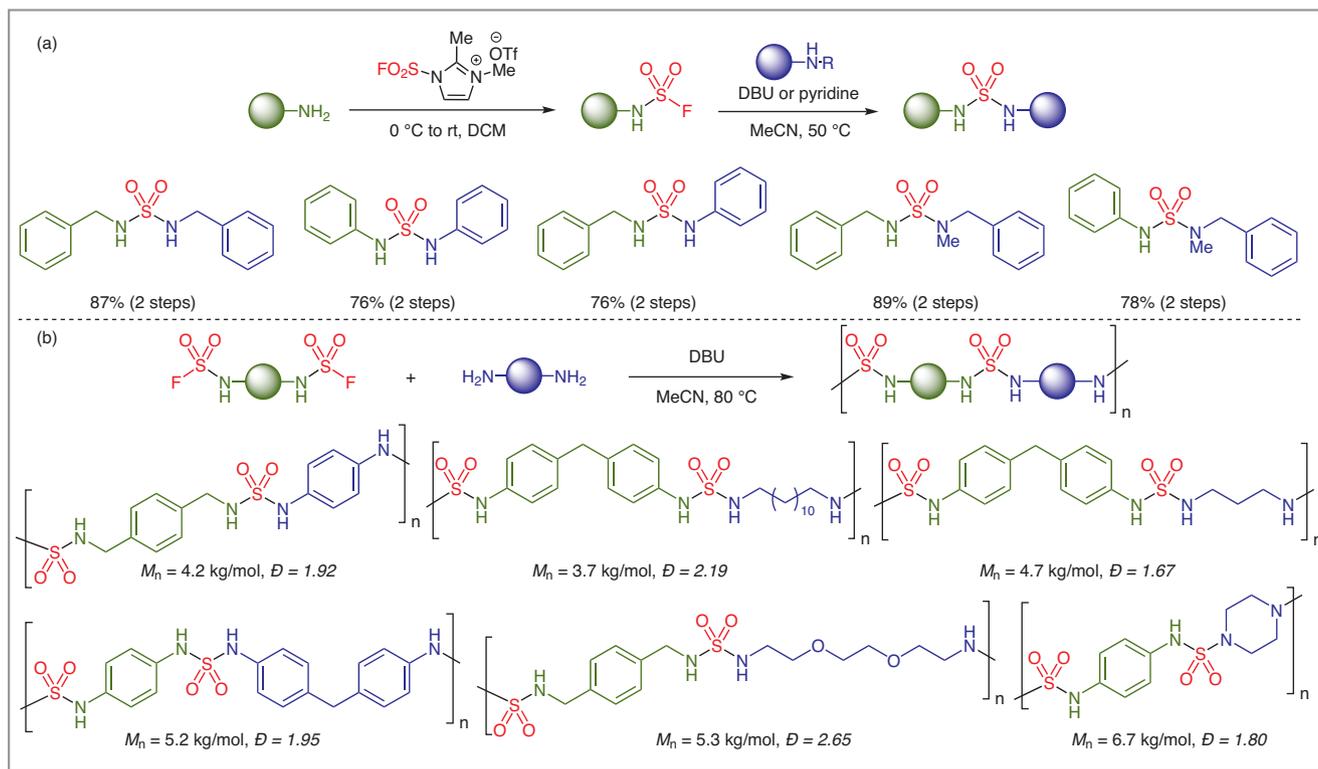
we have produced new polymeric materials, we study their physical properties for potential applications. These investigations include the typical analyses of thermal and mechanical properties, as well as state-of-the-art spectroscopy techniques to unveil the electronic and optical properties of our conjugated materials. Our foray into uncharted polymer space relies first and foremost on the synthesis of many small molecules as monomers, catalysts, or as model substrates to probe chemical reactivity.

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

Prof. Q. Michaudel Convincing a diverse group of talented young scientists to help me launch a new lab and witnessing their scientific growth is certainly the achievement I am most proud of. While we still have a lot of work ahead of us, we have already reached some key milestones. Last year, we reported that the stereoretentive ring-opening metathesis polymerization (ROMP) of a paracyclophane diene monomer enables the preparation of all-*cis* poly(phenylene vinylene)s with perfect stereoselectivity and exquisite control over the polymer chain growth (Scheme 1).² This unique approach enabled the synthesis of photoresponsive diblock copolymers via isomerization of the olefins in the polymer backbone triggered with UV-light. As demonstrated in this study, the level of control afforded by stereoretentive dithiolate Ru-catalysts first prepared by Hoveyda and co-workers³ provides an additional knob for polymer chemists to tune the properties of their materials.⁴ In a second communication,⁵ we described a mild and efficient synthesis of unsymmetrical sulfamides via the SuFEx click reaction pioneered by Sharpless and co-workers.⁶ The optimized conditions delivered a variety of sulfamides from primary and secondary amines in excellent yields (Scheme 2a). Capitalizing on this robust process, we synthesized a



Scheme 1 Synthesis of all-*cis* PPV via stereoretentive ROMP and photoisomerization to the all-*trans* congener.



Scheme 2 Synthesis of sulfamides via SuFEx click chemistry. (a) Reaction development. (b) Application to the synthesis of polysulfamides (selected examples). M_n = Number-average molecular weight; \bar{D} = dispersities.

library of polysulfamides (Scheme 2b), an underexplored family of macromolecules whose properties are tied to their propensity to engage in hydrogen bonding. Aryl polysulfamides were shown to decompose back to the starting bisamine monomer under acid or basic hydrolysis, paving the way for potential polymer recycling. We hope that this new method will facilitate the adoption of sulfamides as bioisosteres, as catalysts, and, more generally, as linchpins for the synthesis of complex molecules, including macromolecules.

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