

Young Career Focus: Professor Erin Stache (Cornell 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 Professor Erin Stache (Cornell University, USA).

Biographical Sketch



Professor E. Stache

Erin Stache received her B.S. in chemistry in 2008 from the University of Wisconsin-Green Bay (USA) and her M.S. in chemistry in 2011 from Colorado State University (USA). After working in industry for several years, she received her Ph.D. in chemistry in 2018 from Colorado State University, advised by Prof. Tomislav Rovis and Prof. Abigail G. Doyle. During her Ph.D., she developed new methods for C–O bond activation using photoredox catalysis. Erin began her postdoctoral studies at Cornell University (USA), working with Prof. Brett P. Fors as a Cornell Presidential Postdoctoral Fellow. Following this appointment, Erin started her independent research career at Cornell University as an assistant professor in the Department of Chemistry and Chemical Biology. Her research focuses on sustainable polymer chemistry, including developing new polymerization methods for biodegradable polymers and identifying novel depolymerization strategies. Erin received the President's Council of Cornell Women 2020–2021 Affinito-Stewart Grant and the Thieme Chemistry Journals Award in 2021.

INTERVIEW

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

Prof. E. Stache My research lab focuses on sustainable polymer chemistry from several different perspectives. Our research is quite interdisciplinary, incorporating elements from organic, physical, and inorganic chemistry. Having completed a Ph.D. in synthetic methodology and a postdoc in polymer synthesis, I hope to combine modern synthetic methods with polymer and materials synthesis. Utilizing elements of photoredox catalysis, transition-metal catalysis, and biocatalysis, we will develop novel polymerizations of biodegradable materials, identify novel biorenewable monomers, and advance depolymerization strategies for commodity polymers.

SYNFORM *When did you get interested in synthesis?*

Prof. E. Stache I remember very specifically when I became interested in organic synthesis – drawing my first arrow-pushing mechanism. I initially intended to pursue medical school to become a doctor, but the first semester of organic chemistry completely changed my trajectory. The mechanism was probably hydration or hydrobromination of an alkene, and drawing the flow of electrons through arrows just made sense. I decided to pursue an REU program at Georgia Tech (USA) with Prof. Seth Marder, followed by graduate studies at Colorado State University (USA) with Prof. Eric Ferreira. I developed C–H functionalization reactions using a transient directing group strategy.¹ A Ph.D. is full of ups and downs, and there was a period where I left the program to explore other career options. I worked as a veterinary assistant, a quality control chemist at Tolmar, Inc., a summer instructor for organic chemistry, and finally, as a development engineer at HRL Laboratories in Malibu, CA, USA. At HRL, I developed methods in materials engineering, which propelled me to finish my Ph.D. so I could pursue a career in academia. I resumed my Ph.D. at CSU with Prof. Tom Rovis but conducted my research

at Princeton (USA) in collaboration with Prof. Abby Doyle. At Princeton, we exploited photoredox catalysis for asymmetric transformations, as well as new bond activations.^{2,3} Wanting to continue in polymer chemistry and polymer synthesis, I joined the lab of Prof. Brett Fors as a Cornell Presidential Post-doctoral Fellow. At Cornell, relying on my synthetic roots, we developed a hydrogen-atom transfer RAFT polymerization to graft polymers controllably from C–H bonds.⁴ I was fortunate enough to obtain a tenure-track faculty position at Cornell, where I started my independent research lab in July 2020.

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

Prof. E. Stache Organic synthesis has transformed our society in countless ways, from drug discovery to the development of plastics. With time, synthesis has become much more sophisticated, but the challenges we still face are increasingly complicated. For example, we've spent more than 50 years perfecting the synthesis of plastics essential to our everyday lives. Still, we've come to realize that the invention of commercial plastics is now one of the most significant challenges we face.⁵ In addition to developing synthetic strategies to upcycle these recalcitrant materials, we must develop new materials from biorenewable sources and those that can be recycled while not losing physical properties. This means

creating more efficient strategies for monomer synthesis and the development of new polymerization techniques. All these challenges, and with them, opportunities, rely on the continued development and sophistication of organic synthesis.

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

Prof. E. Stache As one might deduce from my thoughts on the future role of synthesis, my research lab heavily focuses on sustainable polymer chemistry. When we design research projects and goals, we think about reimagining the life cycle of a polymeric material (Figure 1). Monomers frequently come from petroleum feedstocks, particularly those we use daily, like ethylene, propylene, and styrene. We see this as an opportunity to develop syntheses of new monomers or develop new polymerization strategies to repurpose biorenewable monomers to synthesize these high-performance plastics. The other focus of our group is to develop strategies to deal with existing plastic waste. The economic viability of mass-producing non-recyclable polymers is a formidable foe, so it's essential to address the plastic waste crisis from degrading commercial polymers as well. We are developing synthetic strategies to degrade, upcycle, and chemically recycle commercial polymers, relying on modern synthetic methods and catalysis.

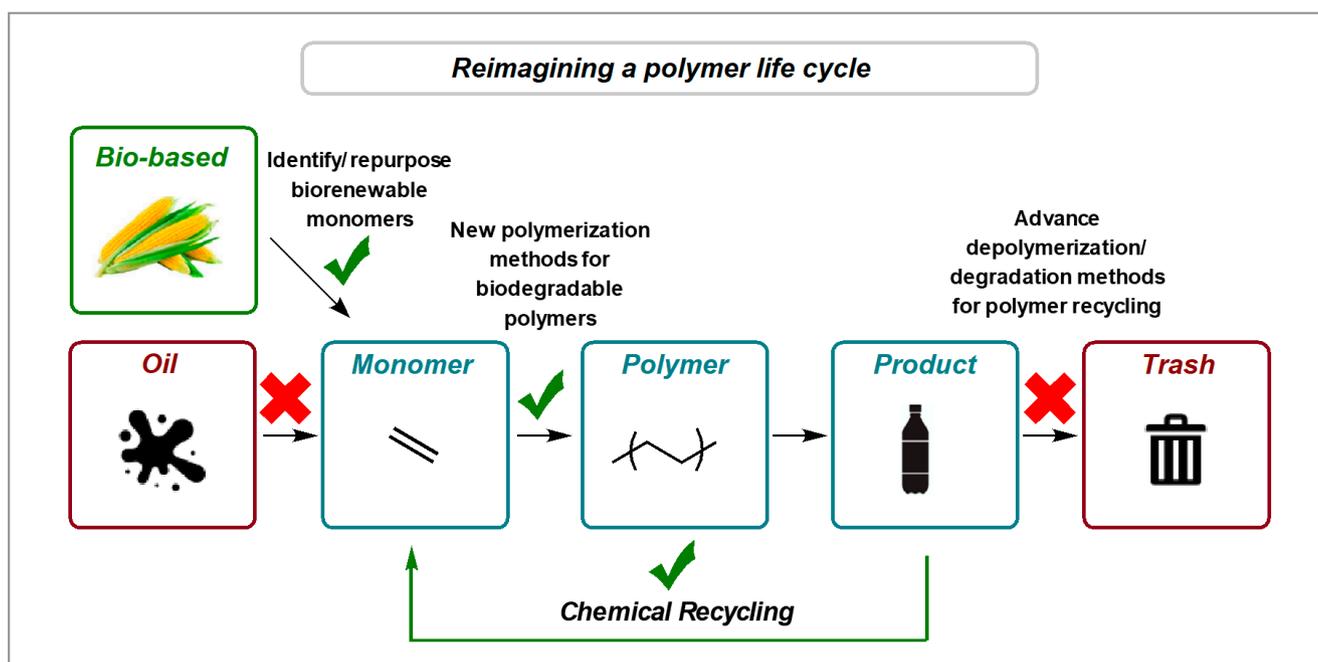


Figure 1 Proposed life cycle of a polymeric material

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

Prof. E. Stache My most important scientific achievement is believing enough in my abilities to return to graduate school and finish my Ph.D. I certainly didn't do it alone – I had incredible mentors both in industry and academia who supported and encouraged me the entire way. Without it, I wouldn't have the opportunities I have now to start a research program with some fantastic graduate students, giving them a chance to learn, grow, and make their impact on the scientific community and the world. I also hope that my non-traditional trajectory towards academia shows there is no single or “correct” path to a career. Even if a career path gets interrupted or off-track, success is achievable in the end with hard work and perseverance.



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