Young Career Focus: Dr. Xiaoran Hu (Syracuse 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 Dr. Xiaoran Hu (Syracuse University, USA).

Biographical Sketch

Dr. X. Hu

Xiaoran Hu grew up in Henan province (P. R. of China) and received a B.S. in chemistry from Nanjing University in 2010. During his doctoral studies with Prof. Samuel Thomas at Tufts University (USA, 2012–2017), Xiaoran developed strategies to photo-control polymer self-assembly and cargo release. Xiaoran then conducted postdoctoral research in polymer mechanochemistry in the Division of Chemistry and Chemical Engineering at Caltech (USA, 2017–2021), mentored by Prof. Maxwell Robb. After that, Xiaoran furthered his postdoctoral training in biomaterials and drug delivery with Profs. Shaoyi Jiang in the Meinig School of Biomedical Engineering and Geoffrey Coates in the Department of Chemistry and Chemical Biology at Cornell University (USA, 2021–2022). Dr. Xiaoran Hu joined the faculty at Syracuse University (USA) in 2022, where his group's research has been dedicated to the development of stimuli-responsive chemistry for sensing and controlled-release applications.

INTERVIEW

SYNFORM *Which field of organic chemistry are you interested in the most and why?*

Dr. X. Hu I am mostly interested in stimuli-responsive organic materials. In this branch of organic chemistry, we focus on designing new molecules and building bonds in such a way that these molecules, once prepared, can be deconstructed or manipulated in predictable ways by applying external stimuli such as ultrasound[1–3] and light.[4–6]

Even before majoring in chemistry, I've always been intrigued by the wide variety of materials that are part of our daily lives, the reason behind their differing properties, and how these properties may be controlled. It is a satisfaction to understand the structure–property relationships at the molecular level and use this understanding to rationally design materials with specific properties that can solve real-world problems.

SYNFORM *Following that, what is the focus of your current research activity?*

Dr. X. Hu 'Gated reactivity' involves systems where a reactive species is kept inactive or 'gated' until a particular trigger activates or 'unmasks' the reactivity. Based on this concept, we have developed smart materials and systems for various applications, including sensing and controlled release (Figure 1).

The Hu group at Syracuse University (USA) recently introduced a new method to manipulate the atropisomer stereochemistry of configurational diarylethene mechanophores, thereby regulating diarylethene's photochemical properties.[1,2] Coupling force with stereochemistry and molecular configuration represents a general method, and our group is actively investigating novel configurational mechanophores following this overarching design principle.

Employing the 'gating' concept, our team is also actively working on materials systems for controlled release and drug

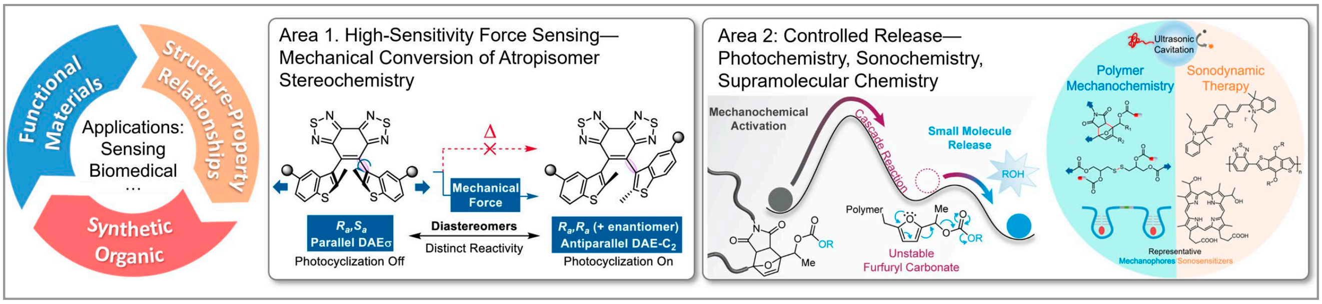

Figure 1 Overview of research in the Xiaoran Hu group at Syracuse University. Reproduced with permission from references 1, 3, and 7. Copyright 2023, American Chemical Society. Copyright 2024, American Chemical Society. Copyright 2019, American Chemical Society.

delivery applications, that are responsive to light, ultrasound, or supramolecular interactions. A couple of manuscripts are under preparation in this direction.

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

Dr. X. Hu Organic chemistry serves as the foundation across various disciplines. For materials chemists, organic chemistry offers valuable insights for designing new materials, fueling hypothesis-driven materials research that extends the limits of current material properties and functionalities. On the other hand, synthetic organic chemistry provides a rich toolbox that enables the construction of new molecules and macromolecules. This capability unlocks remarkable opportunities within the broader fields of science and engineering, offering chemical solutions to global challenges and advancing human well-being.

SYNFORM *Which difficulties are there for young upcoming chemists in your field? Do you have any tips?*

Dr. X. Hu It is important to stay updated with the latest developments in the field, while focusing on identifying and establishing one's research niche that has the potential for sustainable external funding. Moreover, new assistant professors will face responsibilities beyond what is typically covered in graduate and postdoctoral training. This includes building and managing a research group, overseeing research projects while crafting strategic grant proposals, and managing non-research obligations such as teaching and curriculum development.

One tip I have learned from my postdoc mentors on launching a research program is to begin acting on an idea once it is conceived instead of waiting for the perfect idea, while remembering to keep open-minded and flexible during the project and constantly explore new avenues and opportunities as the project progresses.

SYNFORM *Could you tell us something about yourself outside the lab, such as your hobbies or extra-work interests?*

Dr. X. Hu During the COVID pandemic, I discovered a passion for indoor bouldering and now spend a few hours each week climbing at the gym. Additionally, snowboarding is a sport I've enjoyed since early in my graduate school days.

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

Dr. X. Hu The most important of my independent research accomplishments so far is the development of a new type of configurational mechanophore. This work, detailed in our 2023 publication in the *Journal of the American Chemical Society*,[1] introduces an innovative mechanism for converting a mechanophore into its configurational diastereomers. Besides the novelty and generality of the mechanism, our approach features a unique combination of advantages that position it as an enabling technology in high-sensitivity stress sensing: (1) This type of configurational mechanophore features remarkably high mechanosensitivity, evidenced by experimental and computational discoveries reported in our 2023 *J. Am. Chem. Soc.* paper. We will soon submit a new manuscript that focuses on understanding and enhancing the mechanical sensitivity of configurational mechanophores. (2) The conversion of configurational stereochemistry is irreversible and permanent, providing a stable readout that signals the mechanical activation event even after lifting the force. Previous high-sensitivity conformational mechanophores only provide a transient signal under applied force.

Additionally, during my postdoctoral training in Professor Maxwell Robb's lab at Caltech, we developed a furan-maleimide mechanophore system that introduced the concept of controlled release of covalently bound functional molecules through the mechanical effect of ultrasound.[7–10] This mechanistically innovative technology harnesses ultrasound waves to mechanically trigger the release of covalently bound cargo molecules from polymer chains in solution, marking a significant advancement in ultrasound- and force-controlled release systems.

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