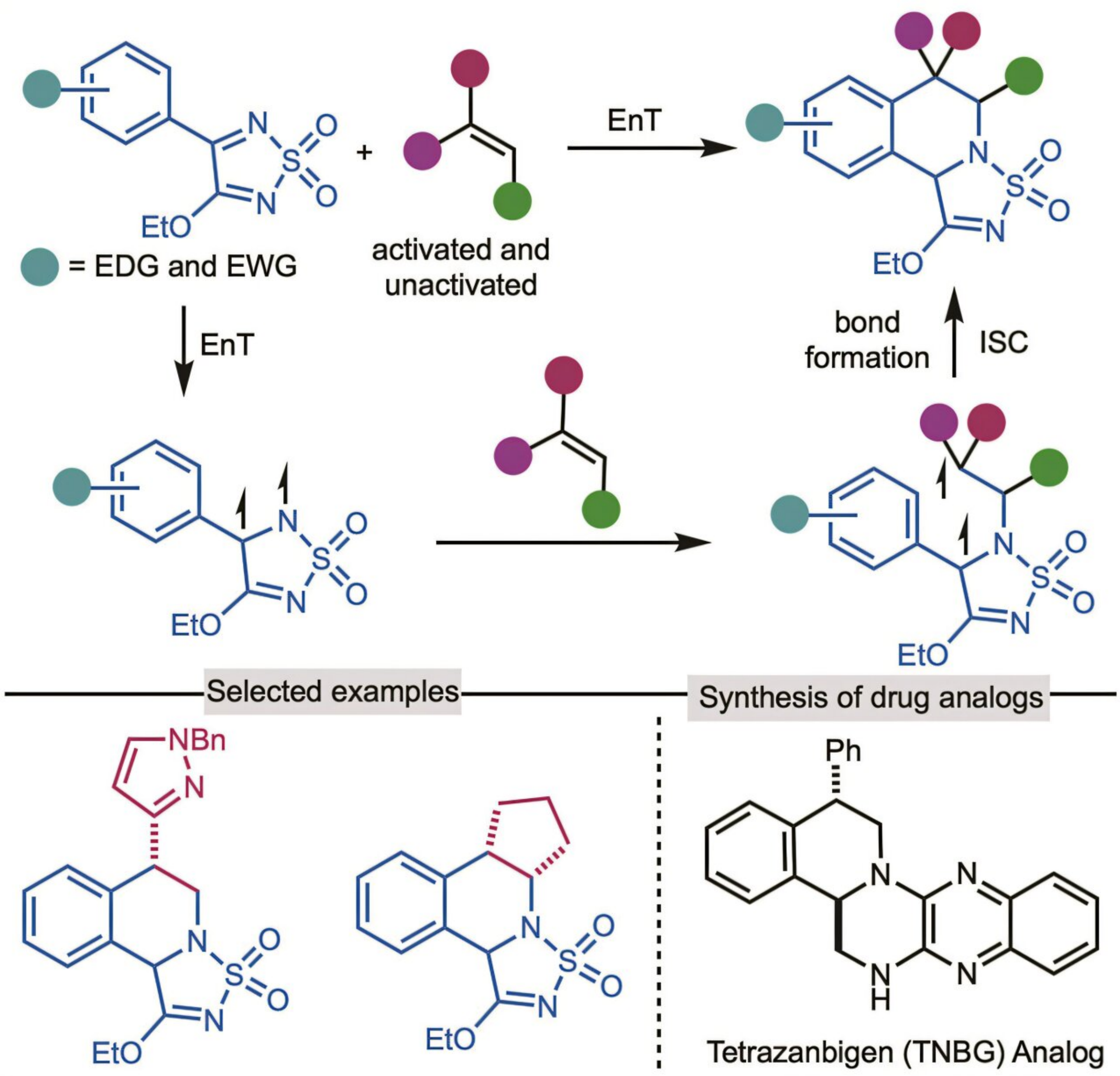
Researchers pioneer groundbreaking light-driven method to create key drug compounds

March 22 2025



Credit: *Chem* (2025). DOI: 10.1016/j.chempr.2025.102488

Researchers at Indiana University and Wuhan University in China have unveiled a groundbreaking chemical process that could streamline the development of pharmaceutical compounds, chemical building blocks that influence how drugs interact with the body. Their study, published in *Chem*, describes a novel light-driven reaction that efficiently produces tetrahydroisoquinolines, a group of chemicals that play a crucial role in medicinal chemistry.

Tetrahydroisoquinolines serve as the foundation for treatments targeting Parkinson's disease, cancer, and cardiovascular disorders. These compounds are commonly found in medications such as painkillers and drugs for high blood pressure, as well as in natural sources like certain plants and marine organisms.

Traditionally, chemists have relied on well-established but limiting methods to synthesize these molecules. The new research, co-authored by Kevin Brown, the James F. Jackson Professor of Chemistry in the College of Arts and Sciences at Indiana University Bloomington, and Professors Xiaotian Qi, Wang Wang, and Bodi Zhao of Wuhan University, presents a fundamentally different approach.

How it works: Light as a chemical tool

Instead of using traditional chemical reactions, scientists harness light to trigger a process called photoinduced energy transfer, wherein light initiates a controlled reaction between sulfonylimines (a type of chemical compound) and alkenes (another type of compound), leading to the creation of tetrahydroisoquinolines—a type of complex molecule. This method allows for the development of new structural patterns in the molecules, which were previously difficult or impossible to create using other methods, offering a more efficient way to make complex molecules.

"The key innovation in this study is the use of a light-activated catalyst, a special molecule that speeds up the reaction without being used up itself," said Professor Brown. "Traditional methods require high temperatures or strong acids—like trying to cook food with a blowtorch instead of a stove. These harsh conditions can sometimes create unwanted side reactions, or make the process less useful for certain chemicals. The new process, however, uses molecules that respond to light, and can bypass heating by access new energy states. This makes the reaction cleaner, more efficient, and less likely to create unwanted byproducts."

Brown and colleagues also found that tiny changes in the location of electrons within the starting materials had a huge impact on how the reaction played out—akin to if these electrons were puzzle pieces that needed to fit together just right. By tweaking the shapes of these pieces, the scientists made sure that only the desired product was formed, making the process highly selective. This is crucial for making medicines, where even a small mistake in a molecule's structure can turn a helpful drug into something useless or even harmful.

Implications for medicine and other industries

"The ability to create a wider range of tetrahydroisoquinoline-based molecules means that medicinal chemists can now explore new drug candidates for treating diseases like Parkinson's, certain types of cancer, and heart conditions," noted Professor Qi. "Right now, some diseases have very few effective treatment options, and this method could help scientists discover new and better drugs more quickly."

Beyond pharmaceuticals, this research could also impact other industries that rely on fine chemicals. In agriculture, for example, similar chemical reactions could be used to develop more effective pesticides or fertilizers. In materials science, it could help create new synthetic materials with specific properties, such as better durability and longevity and greater resistance to heat for the aerospace, automotive, electronics, and medical industries.

The researchers plan to fine-tune the reaction conditions, meaning, they will experiment with different ingredients and settings to make the improve the process further. They also aim to find out if this method can work on even more types of molecules, expanding its usefulness. In addition, they hope to partner with pharmaceutical companies to test whether this technique can be used to produce medicines, potentially leading to new drug discoveries that could make a difference in people's lives.

"This approach gives chemists a powerful new tool," said Professor Brown. "We hope especially it will open the door to the development of new and improved therapies for patients around the world."

As the field of photochemistry continues to expand, innovations like this may redefine how medicines and essential chemicals are made, paving the way for faster, cleaner, and more efficient production methods.

More information: Wang Wang et al, An unconventional photochemical tetrahydroisoquinoline synthesis from sulfonylimines and alkenes, *Chem* (2025). DOI: 10.1016/j.chempr.2025.102488

Provided by Indiana University