



PRESS RELEASE (2026/10/27)

BBcat: A novel anion for more selective and efficient light-driven catalysis

Researchers develop a new photocatalyst that maintains high reaction yields even under diluted conditions

Fukuoka, Japan—Researchers at Kyushu University have developed a photocatalytic system that can selectively capture reacting molecules and hold them close to the active sites that absorb energy from light. This innovation addresses a long-standing challenge of having the photocatalyst maintain a high reaction rate even when the reacting molecules are present at very low concentrations.

Photocatalysis uses light to drive chemical reactions, reducing the need for high temperatures that may be necessary for other conventional catalytic reactions. These catalysts are specifically designed to absorb light and transfer its energy to the reactants. Since energy transfer depends on collisions between the excited photocatalyst and the reacting molecules, these collisions happen less when the reacting molecules are dilute, leading to the reaction becoming slower and less efficient.

To address this limitation, a research team led by [Professor Takanori Iwasaki](#) from Kyushu University's [Faculty of Engineering](#), in collaboration with The University of Tokyo, developed an innovative ionic photocatalytic system. Their study showcases how the counteranion, an often-neglected component of the photocatalyst, can be engineered to enhance reaction selectivity, efficiency, and speed. The results were published in the journal [Chemical Science](#) on October 08, 2026.

The team paired a light-absorbing ruthenium complex with their recently developed counteranion, BBcat. Counteranions are negatively charged ions that accompany positively charged ions in ionic chemical compounds. Although they can influence catalytic reactions, their role in photocatalysis has traditionally focused on their ability to donate electrons. However, BBcat is unique in that it acts as a Lewis acid, meaning it can accept electron pairs. Thus, basic molecules are bound instead of being repelled by BBcat.

In this way, the proposed system can capture specific reacting molecules and hold them near the light-absorbing component. The proposed photocatalytic system increases the likelihood of energy transfer to the reacting molecules without requiring them to be present at high concentrations.

The team tested the proposed photocatalyst in a reaction called [2+2] photocycloaddition, in which light helps two molecules form a four-membered carbon ring. The BBcat-based catalyst produced the desired product with 76% yield. Compared to when a conventional catalyst with a different counteranion is used, the yield is only 24%. Notably, under more diluted conditions, the BBcat-based system maintained a product yield of 75%, while the conventional catalyst's

yield fell to 9%.

The findings show that the counteranion can influence selectivity toward specific reactants and enhance activity. “Imparting strong acidity to an anion makes it possible to move beyond the conventional view of anions as bases and use the photocatalyst’s counteranion itself as a substrate-recognition site,” says Iwasaki. He notes that their approach could provide a new way to design photocatalysts for reactions that require selective substrate activation or operate at low concentrations.

The researchers point out that BBcat’s function may also be incorporated into other catalytic systems. “Because cationic transition metal catalysts are widely used in laboratories and industry, the introduction of BBcat to these catalysts as a counteranion can be achieved via simple mixing,” Iwasaki explains. “Thus, the selective transformation and reaction rate acceleration functions enabled by BBcat—selective capturing of basic substrates—can be readily combined with other transition metal catalysis.”

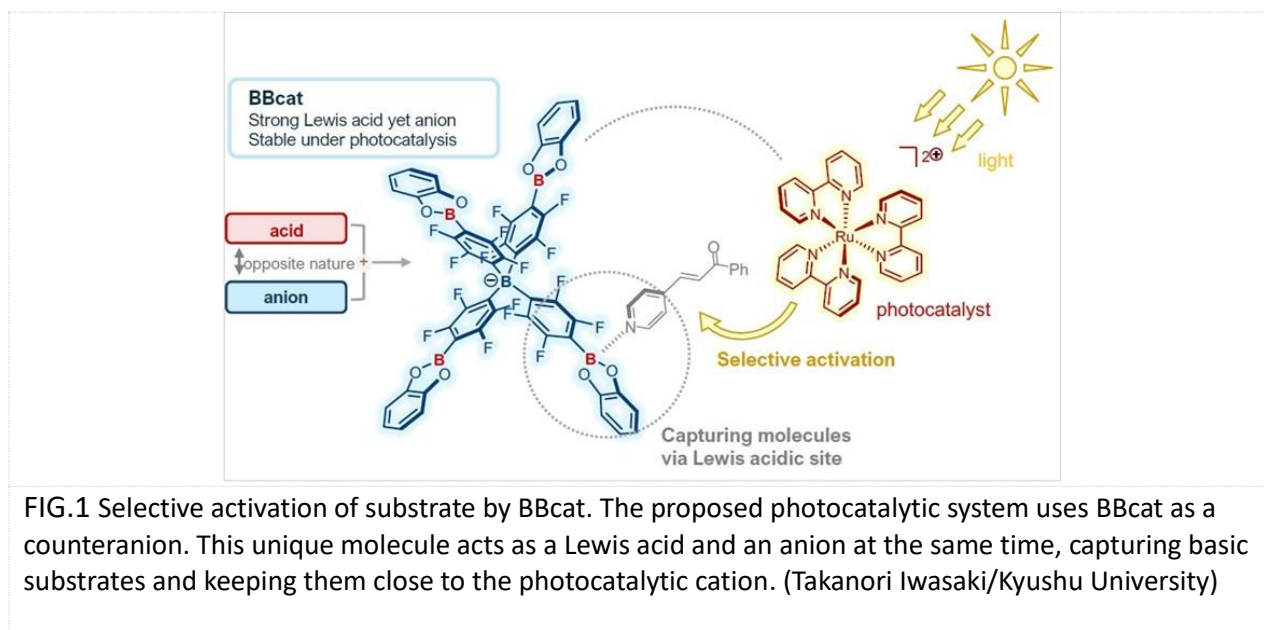
This work could help establish counteranion design as a practical strategy for enhancing selectivity and efficiency in photocatalysis, improving the production of valuable compounds.

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For more information about this research, see “A Lewis-Acidic Anion Enhances Energy Transfer from Excited Cationic Photocatalysts to Basic Substrates,” Ryo Mandai, Yuri Oyama, Takanori Iwasaki, and Kyoko Nozaki, *Chemical Science*, <https://doi.org/10.1039/D6SC06879K>.

About Kyushu University

Founded in 1911, [Kyushu University](#) is one of Japan’s leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World University Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan’s four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world’s most livable cities and historically known as Japan’s gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its [VISION 2030](#), Kyushu U will “drive social change with integrative knowledge.” By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society’s most pressing issues.



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