Solar-driven green synthesis of epoxides

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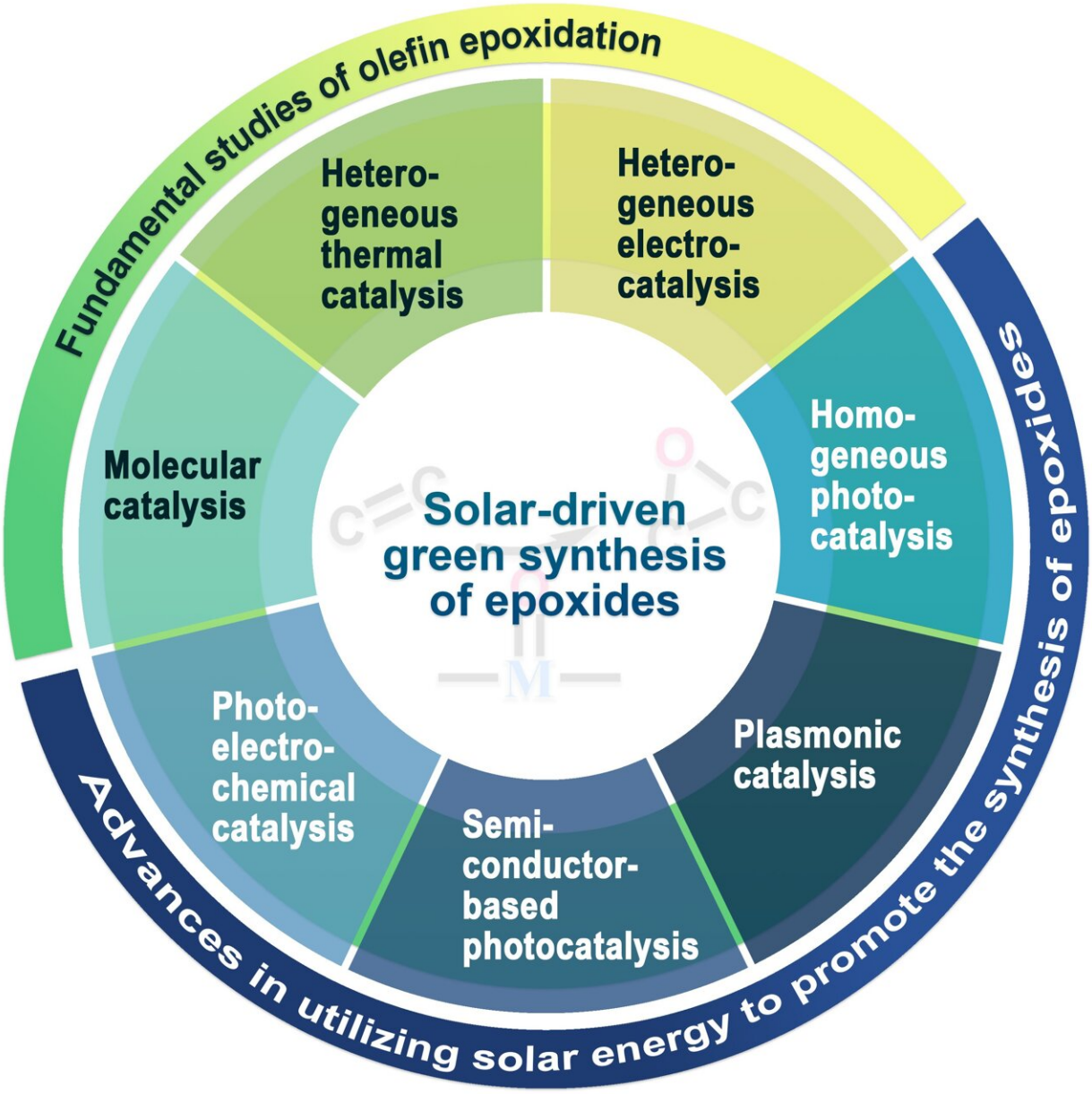

Recent progress towards the photo(electro)synthesis of epoxides. Credit: Science

Research published in the journal *Science China Chemistry* is expected to serve as comprehensive background knowledge and to provide researchers with insight into the recent developments of solar-driven green synthesis of epoxides.

The review was led by Prof. Yuchao Zhang (Key Laboratory of Photochemistry, CAS Research/Education Center for Excellence in Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences)

"Epoxides play a pivotal role in industrial production, serving as essential building blocks or intermediates for synthesizing various high-value chemicals. Traditional preparation methods often rely on hazardous oxidants (such as peroxy acids) or extensive fossil fuel-powered thermal catalytic systems, resulting in significant CO_2 emissions and waste production," Zhang says.

"Solar energy represents the most promising renewable energy source for a sustainable society. Recently, solar-driven photo(electro)chemistry has shown advantages in achieving the environmentally friendly synthesis of epoxides."

"For instance, hot electrons or local thermal effects generated on plasmonic photocatalysts can effectively lower the O_2 activation temperature in the thermal catalysis system, and a photoelectrochemical system can efficiently reduce the applied voltage in the electrochemical halide-mediated indirect epoxidation process."

"However, there are still challenges that need to be addressed, including

improving the efficiency of photo (electro)catalytic systems and gaining a deeper understanding of catalytic selectivity in epoxidation. A comprehensive review on this topic will provide further insights into this field and attract more researchers' attention to it."

In this review, the fundamental studies and reaction mechanisms of olefin epoxidation in three typical catalytic systems—molecular catalysis, heterogeneous thermal catalysis, and electrocatalysis—are summarized. Next, recent advances in utilizing solar energy to promote the synthesis of epoxides are discussed. Finally, insights into future perspectives on engineering photo(electro)chemical systems for efficient epoxide production are proposed.

More information: Daojian Tang et al, Solar-driven green synthesis of epoxides, *Science China Chemistry* (2023). DOI: 10.1007/s11426-023-1757-4

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