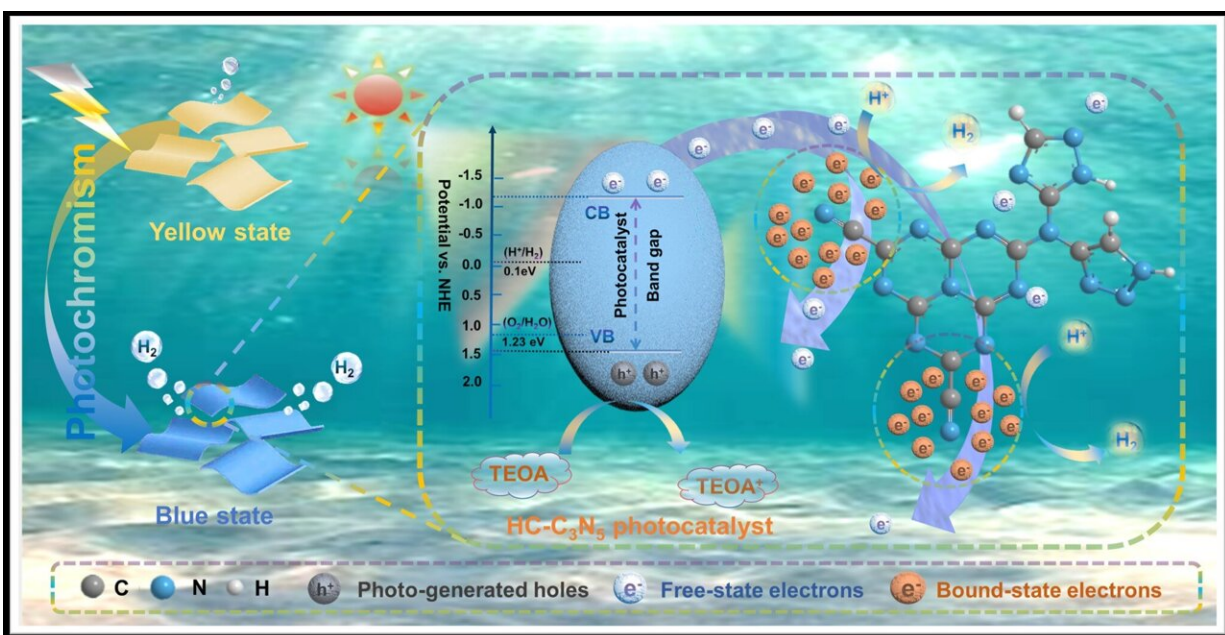


Study reveals insights into the establishment of bound electronic states for developing efficient photocatalysts

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Schematic illustration for the mechanism of photochromic enhanced hydrogen production process over HC-C₃N₅ nanosheets. Credit: Shen, Yu, et al.

Photocatalytic water splitting, a sustainable energy strategy, utilizes solar energy to produce clean hydrogen fuel. While it offers a promising solution to the global energy crisis and environmental pollution, the slow kinetics of photogenerated electron-hole pairs result in low activity for

most semiconductor materials, even with sacrificial agents. To that end, integrating electron traps and reactive centers could be a feasible strategy to enhance charge separation and catalytic performance.

In a new study, researchers at Jiangsu University of Science and Technology and Zhejiang Ocean University synthesized high-crystallinity nitrogen-rich carbon nitride nanosheet photocatalysts via an alkali potassium salt-assisted molten salt method, promoting photocatalytic hydrogen evolution. The researchers [published](#) their findings in *Advanced Powder Materials*.

"We elucidated the role of bound-state electrons in broadening the absorption spectrum and generating photogenerated charges and verified the electron migration pathway induced by cyanide groups, coordinating the transition of photoexcited electrons from an unbound to a bound state," says co-corresponding author Shijie Li.

The team synthesized the exceptional performance of highly crystalline C_3N_5 (HC- C_3N_5) nanosheet as a photocatalyst, demonstrating a hydrogen evolution rate of $3.01 \text{ mmol h}^{-1} \text{ g}^{-1}$, which surpasses that of bulk C_3N_5 (B- C_3N_5) by a factor of 3.27.

"Experimental and theoretical analyses reveal that HC- C_3N_5 nanosheets exhibit macroscopic photoinduced color changes, effectively broadening the [absorption spectrum](#) and significantly enhancing the generation of excitons," explains Weilong Shi.

Notably, the team discovered potential electron capture sites, which contributed to understanding complex reaction kinetics, strengthening [charge separation](#) dynamics during photocatalytic hydrogen production.

More information: Yu Shen et al, Bound-state electrons synergy over photochromic high-crystalline C₃N₅ nanosheets in enhancing charge separation for photocatalytic H₂ production, *Advanced Powder Materials* (2024). [DOI: 10.1016/j.apmate.2024.100202](https://doi.org/10.1016/j.apmate.2024.100202)

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