Combined alkali-photocatalytic stimulation enables click microbial domestication for boosted ammonia nitrogen removal

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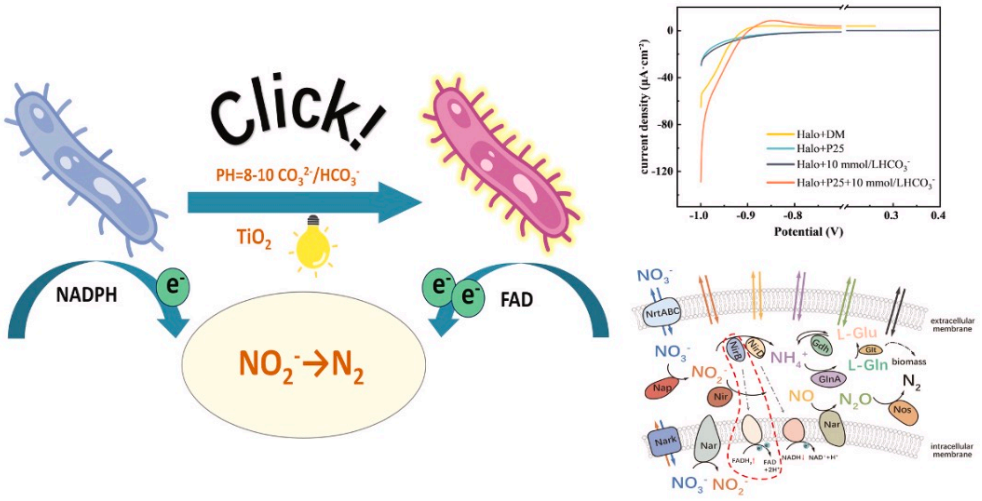
HIGHLIGHTS

- A combined alkali-photocatalytic (CAP) promotion strategy was developed to activate bacteria.
- Improved electrochemical properties in DWK9 bacteria suggest effective electron migration.
- Favorable denitrification-related metabolic pathway genes change were verified.
- The 2-electrons pathway dominated by FAD is the core promotion mechanism.

GRAPHICAL ABSTRACT



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ABSTRACT

Microbe-driven ammonia nitrogen removal plays a crucial role in the nitrogen cycle and wastewater treatment. However, the rational methods and mechanisms for boosting nitrogen conversion through microbial domestication are still limited. Herein, a combined alkali-photocatalytic stimulation strategy was developed to activate the *Halomonas shizuishanensis* DWK9 for efficient ammonia nitrogen removal. The strain DWK9 selected from saline-alkaline soil in Northwestern China possessed strong resistance to stress of saline-alkaline environment and free radicals, and was abundant in nitrogen conversion genes, thus is an ideal model for advanced microbial domestication. Bacterial in the combined alkali-photocatalytic stimulation group achieved a high ammonia nitrogen conversion rate of 67.5 %, 10 times outperforming the non-stimulated and single alkali/photocatalytic stimulation control groups. Morphology analysis revealed that the bacteria in the alkali-photocatalytic stimulated group formed a favorable structure for bioelectric transfer. Remarkably, the domesticated bacteria