

[Request Information](#)

[Permalink](#)

## Heterologous Synthesis of Nitrogenase in E. coli

Tech ID: 33567 / UC Case 2024-999-0

### CONTACT

Edward Hsieh  
hsiehe5@uci.edu  
tel: 949-824-8428.



### INVENTORS

- » Hu, Yilin
- » Lee, Chi Chung
- » Ribbe, Markus W.

### OTHER INFORMATION

### CATEGORIZED AS

- » **Agriculture & Animal Science**
  - » Chemicals
  - » Transgenics
- » **Biotechnology**
  - » Food

### RELATED CASES

2024-999-0

## BRIEF DESCRIPTION

A groundbreaking synthesis of simplified nitrogenase analogs in *E. coli*, facilitating nitrogen fixation in a non-diazotrophic organism. This synthesis provides the foundation for replacing fossil-fuel generated ammonia fertilizer with nitrogen fertilizer generated from a bacteria that is well-studied and already used in the biotech field.

## SUGGESTED USES

Agriculture

## FEATURES/BENEFITS

- Introduces nitrogen-fixing capabilities to non-diazotrophic organisms.
- Simplifies the transfer and expression of nitrogenase genes.
- Enables the modular synthesis and optimization of nitrogenase components.
- Facilitates the development of nitrogenase-based biotechnological applications.
- Promises advancements in agriculture, energy, and environmental management.

## FULL DESCRIPTION

Biological nitrogen fixation (BNF) offers a natural means of supplying fixed nitrogen to crops. Catalyzed by a metallo-enzyme called nitrogenase, the BNF process converts  $N_2$  to  $NH_3$  at ambient conditions, circumventing the problems of fossil-fuel consumption and carbon-waste production associated with its industrial parallel while reducing the nitrogen-cycle perturbation and the surface/ground-water pollution caused by the excess application of commercial ammonia. However, BNF bacteria are difficult to grow and not suitable for all plant conditions. The expression of nitrogenase in an organism that can be cultured and mass-produced in a lab is a long-sought-after, yet non-trivial task given the necessity to introduce a large number (more than 20) of nitrogen fixation (*nif*) and related genes into a new host. Researchers have completed heterologous synthesis of two simplified nitrogenase analogs from *Azotobacter vinelandii* in *E. coli*. One analog consists of the reductase component (NifH) and, in place of the catalytic component (NifDK), a cofactor maturase (NifEN); whereas the other analog consists of only NifEN. Both systems mimic the nitrogenase enzyme in reducing  $N_2$  and incorporating the reduced N into the cellular mass.

## PATENT STATUS

Patent Pending

## STATE OF DEVELOPMENT

Lab results show successful synthesis of nitrogenase and incorporation of nitrogen into *E. coli* cells. Experiments are being performed to translate this same process in other soil bacteria.

## OTHER INFORMATION

Provisional patent filed

