Insights: Publications

An engineered, non-diazotrophic cyanobacterium and its application in bioelectrochemical nitrogen fixation

Cell Reports Physical Science 2 (6)

JUNE 23, 2021 Written by

The reduction of chemically inert nitrogen to ammonia is a critical step in the global nitrogen cycle. Microbial nitrogen fixation is a promising way to realize nitrogen reduction and ammonia production at mild conditions. Here, we report an engineered, non-diazotrophic Synechococcus elongatus PCC 7942 strain with nitrogen fixation activity that is constructed by integrating a modified nitrogenase gene cluster into the genome. The engineered S. elongatus PCC 7942 strain is employed in a bioelectrochemical nitrogen-fixation (e-BNF) system for ammonia production. Because the e-BNF system supplies adequate external electrons for the turnover of nitrogenase, the nitrogen fixation activity of the engineered S. elongatus PCC 7942 strain is significantly improved. After 48 h of reaction, the e-BNF system accumulates 173 μM of NH3, which is 21 times higher than that generated from solely photosynthesis-driven nitrogen fixation, with faradaic efficiency of 6.85%. This work may provide new insight into biological nitrogen-fixation systems and ammonium production.