

Oxygen tolerant hydrogenases by mutating electron supply pathway

Stanford researchers at the Swartz Research Group have engineered an Iron-Iron (Fe-Fe) hydrogenase with as high as 5-fold enhancement in O₂ tolerance by introducing cysteine mutations around the electron supply pathway within the enzyme. The best mutant can sustain at least 15% of the anaerobic H₂ production activity for an hour in the presence of 5% O₂. This advance is a key step toward sustainable H₂ production using sunlight as the energy source since this process does not release greenhouse gas emissions. Currently, 38% of California's energy comes from gaseous fuels in the form of natural gas which release huge quantities of carbon dioxide. This invention will help curb global warming by providing an alternative and sustainable supply of gaseous fuels.

Figure

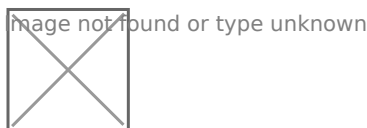


Figure description - Double cysteine introduction confers oxygen tolerance during hydrogen production.

Applications

- Sustainable biological hydrogen production
- Useful for many technologies where oxygen exposure is possible or probable:
 - Photosynthetic hydrogen production in engineered organisms
 - Hydrogen production in which electrons are supplied by pathways within cell-free cellular extracts
 - Technologies in which reducing equivalents are supplied by electricity or by photovoltaic or photocatalytic devices

Advantages

- **Dramatic improvement in oxygen tolerance** while producing hydrogen
- **Enzymatic stability**
- **Method applicable to study similar or combination of mutations** to improve hydrogenase stability
- **Environmentally friendly**- process does not emit CO₂ unlike natural gas

Publications

- Jamin Koo, James R. Swartz, "[System analysis and improved \[FeFe\] hydrogenase O₂ tolerance suggest feasibility for photosynthetic H₂ production](#)" Metabolic Engineering 49 (2018) 21-27.

Patents

- Published Application: [20170067034](#)
- Issued: [10,221,401 \(USA\)](#)

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