Hydrocarbon Production, H2 Evolution And CO2 Conversion By Whole Cells Or Engineered Azotobacter Vinelandii Strains

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BRIEF DESCRIPTION

Using metal catalysts in industrial synthesis of hydrocarbons for fuels can be costly, inefficient, and harmful to the environment. This simple approach uses genetically-modified soil bacterium to synthesize valuable hydrocarbons using recycled components. This novel process is environmentally-friendly and is more cost- and energy-efficient than current industrial synthesis.

FULL DESCRIPTION

Hydrocarbons isolated primarily from fossil fuels (e.g., natural gas) are widely used as fuels and commercial products. Such natural sources of hydrocarbons are available in limited supply and their retrieval and processing can pose negative environmental effects. Undesirable chemicals such as carbon monoxide, which are thought to contribute to global warming, can come from combusting fossil fuels. Alternative sources of hydrocarbons are produced from industrial synthesis using metal catalysts. Industrial metal-catalyzed hydrocarbon synthesis requires high temperatures and pressures, as well as expensive reactor-related expenses. The high energy and cost demands, coupled with low efficiency inhibits widespread use. A system and method of converting undesirable chemicals to valuable hydrocarbons under low costs and mild energy conditions appropriate for large-scale fuel production is needed.

UCI researchers have developed methods and compositions for genetically modifying soil bacterium (Azotobacter vinelandii) to express nitrogenase enzymes, which catalyze hydrocarbon synthesis from carbon monoxide in repeated cycles. Replacing metal catalysts with enzymes enables running complex reactions at mild conditions without costly reactors to produce hydrocarbons with high efficiency. The bacterial enzymes convert CO2 to CO, the starting material for hydrocarbon synthesis, and in turn produce hydrogen gas, a valuable clean energy source. The use of bacterial nitrogenase enzymes represent an attractive approach to explore and develop alternative ways to recycle atmospheric CO2 into biofuels while serving the need for cost- and energy-efficient industrial production of biofuels.

ADVANTAGES

Novel:

» Simple production of fuels that simultaneously combats global warming and energy shortages

» First described bacterial enzyme catalyst for hydrocarbon synthesis

Efficient and economic:

» Recycles harmful waste products into valuable hydrocarbons with high efficiency

» Green reaction runs at mild conditions and produce clean energy source

» Expensive reactor not needed

» Energy-efficient method recycles cheap, plentiful, or undesirable chemicals

STATE OF DEVELOPMENT

Proof of concept has been demonstrated in preliminary experiments

» Specified genetic modifications of bacterium Azotobacter vinelandii

» Demonstrated time-course of bacterial enzyme activity with varying amounts of CO

» Experiments run at room temperature and atmospheric pressure

» Prospectively generate a medium scale-fermenter-based prototype

PATENT STATUS

2016-331-0
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Patent Pending