Photobiological CO$_2$ Fixation and Biofuel Production

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Biology

Radiation transfer

Photobiological H$_2$ production

Light (energy source)

H$_2$O (electron source)

CO$_2$ (carbon source)

Cyanobacteria or Algae

H$_2$ → Fuel cells

O$_2$ → Biodiesel

lipids → Industrial process

Biomass

Pharmaceutical products

Fertilizer

Pyrolysis

Fibrous materials

Food

Anabaena Variabilis (cyanobacteria)

Rhodobacter sphaeroides (purple non-sulfur bacteria)

Chlamydomonas reinhardtii (green algae)
Photobiological CO₂ Fixation and Biofuel Production

– Patent pending method to find optimum conditions for
  • Maximum growth and CO₂ fixation
  • Maximum biofuel production rate

– Simulation tools for designing outdoor photobioreactor
  • Accounts for spectral absorption and scattering by algae, bubbles, etc.

– Technology to controlled sunlight delivery

Benchtop photobioreactor

Light delivery system (patent pending)

Full scale system
Waste Heat Harvesting Using Pyroelectric Materials

Material Synthesis

Material Characterization and Modeling

Device based on Olsen cycle

Device Simulations