

Artificial Photosynthesis



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Agenda

- Introduction
- What is Artificial Photosynthesis?
- Splitting CO₂ with a Catalyst
- Bacteria Breaking Down CO₂
- Converting Biofuels by a Photoelectrochemical Cell
- Conclusion



Artificial Photosynthesis

- Converting sunlight, CO₂, and water to oxygen/fuel through unnatural processes
 - Benefits:
 - Reduces excess CO₂
 - Environmentally friendly
 - Renewable
 - Instantaneous
 - Limitations:
 - Production low
 - Expensive
1. Lewis, Nathan S. (1995) "Artificial Photosynthesis."



Dig Info
www.diginfo.tv

Splitting CO₂ with a Catalyst

- CO₂ → CO + ½O₂
- Catalyst - as substance that causes or speeds up a chemical reaction
- Ruthenium is fastest/most efficient
- Cons
 - Not readily available or cheap
 - Produces CO
 - Low amount of O₂ produced

Ruthenium (Ru)

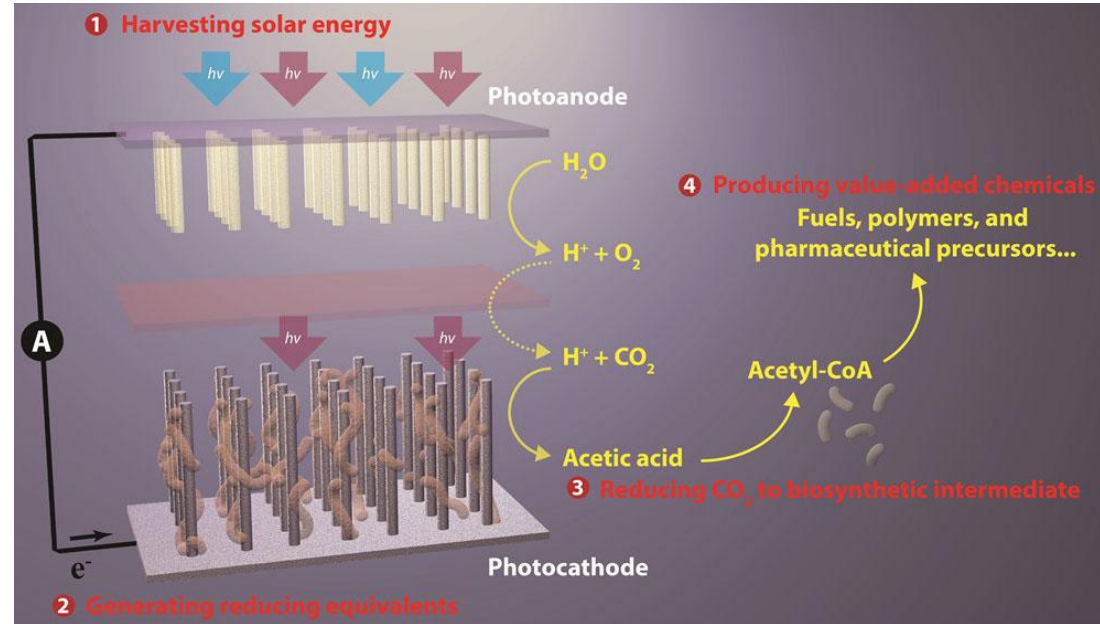


RWMMint
www.rwmmint.com

1. Zuofeng, Chen. (2015). Splitting CO₂ into CO and O₂ by a Single Catalyst..

Bacteria Breaking Down CO2

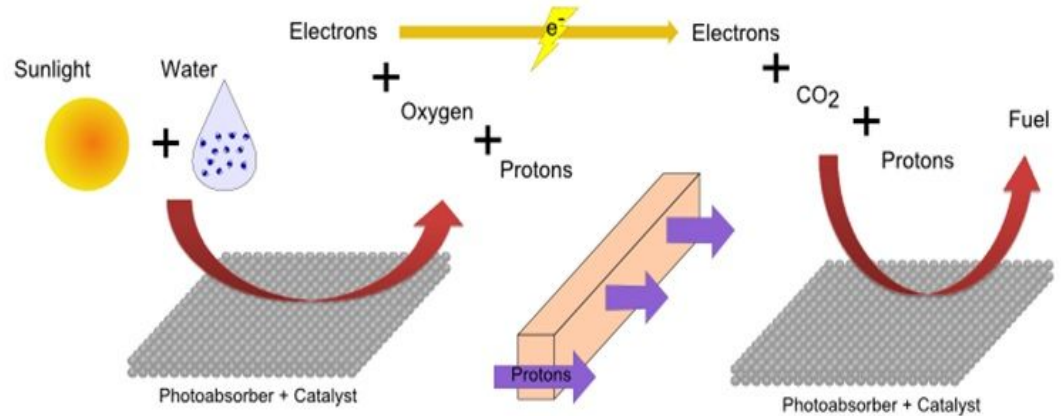
- Energy from sunlight
 - Nanowires
 - CO2 reducing bacteria
 - Produces acetate
 - Fuel and polymers
 - Cons
 - 3% efficiency
 - Short lifespan
 - Goal for consumer availability
 - 10% efficiency
1. Liu, (2015). Nanowire-Bacteria Hybrids for Unassisted Solar Carbon Dioxide Fixation to Value-Added Chemical.



Nano Work
<http://www.nanowork.com>

Converting Biofuels by a Photoelectrochemical Cell

- Convert water and sunlight into fuel
 - Photo-absorber and Catalysts
- Cons:
 - Produces small amount of hydrogen
 - Hydrogen fuel cannot be used efficiently yet
 - Costly/Not efficient



Stanford

<http://www-ssrl.slac.stanford.edu>

1. Gust. (2009). *Solar Fuels via Artificial Photosynthesis*. American Chemical Society,

Conclusion

- What is Artificial Photosynthesis?
- Three Methods
 - CO₂ can be split with catalyst
 - Reducing CO₂ with bacteria to produce fuel
 - Converting Biofuels by a Photoelectrochemical Cell
- Pros: Utilizing the sun to create environmentally beneficial fuels/oxygen
- Cons: Renewable resources are expensive/inefficient
- Looking to become more efficient in the future



References

Gust, Devens, Thomas A. Moore, and Ana L. Moore. "Solar Fuels via Artificial Photosynthesis." *Accounts of Chemical Research* 42.12 (2009): 1890-1898. *Solar Fuels via Artificial Photosynthesis*. American Chemical Society, 17 July 2009. Web. 23 Sept. 2015. <<http://pubs.acs.org.proxy.lib.ohio-state.edu/doi/pdf/10.1021/ar900209b>>.

Lewis, Nathan S. "Artificial Photosynthesis." *American Scientist*. 6th ed. Vol. 83. N.p.: Sigma Xi, The Scientific Research Society, 1995. 534-41. Print.

Liu, Chong, Joseph J. Gallagher, Kelsey K. Sakimoto, Eva M. Nichols, Christopher J. Chang, Michelle C. Chang, Peidon Yang. "Nanowire-Bacteria Hybrids for Unassisted Solar Carbon Dioxide Fixation to Value-Added Chemical." *Nano Letters* 15.5 (2015): 3634-3639. American Chemical Society, 13 April 2015. Web. 20 October 2015. <<http://pubs.acs.org/doi/pdf/10.1021/acs.nanolett.5b01254>>

Zuofeng, Chen. "Splitting CO₂ into CO and O₂ by a Single Catalyst." *Proceedings of the National Academy of Science of the United States of America*. N.p., 25 Apr. 2012. Web. 24 Sept. 2015.

