

Thanks for the feedback!
[Undo](#)
 We'll use your feedback to review ads on this site.

https://www.sciencedaily.com/releases/2016/03/160324154016.htm

Google

Science News

from research organizations

New catalyst is three times better at splitting water

Date: March 24, 2016

Source: SLAC National Accelerator Laboratory

Summary: With a combination of theory and clever, meticulous gel-making, scientists have developed a new type of catalyst that's three times better than the previous record-holder at splitting water into hydrogen and oxygen -- the vital first step in making fuels from renewable solar and wind power.

Share:
 [f](#)
[Twitter](#)
[G+](#)
[in](#)
[+](#)
[Email](#)

PEG and PEG Derivatives

High Quality, Branched, Multi-arm Custom Synthesis, cGMP Quality

•
 [O](#)



FULL STORY



One way to store intermittent sun and wind energy is to use it to split water into oxygen and hydrogen, and then use the hydrogen as fuel. Now scientists at SLAC and the University of Toronto have invented a new type of catalyst that makes this process three times more efficient. In this water-splitting device on the Toronto campus, hydrogen is bubbling up from the left electrode and oxygen is bubbling up from the right one.

Credit: Marit Mitchell/University of Toronto

With a combination of theory and clever, meticulous gel-making, scientists from the Department of Energy's SLAC National Accelerator Laboratory and the University of Toronto have developed a new type of catalyst that's three times better than the previous record-holder at splitting water into hydrogen and oxygen -- the vital first step in making fuels from renewable solar and wind power.

The research, published today in the journal *Science*, outlines a potential way to make a future generation of water-splitting catalysts from three abundant metals -- iron, cobalt and tungsten -- rather than the rare, costly metals that many of today's catalysts rely on.

"The good things about this catalyst are that it's easy to make, its production can be very easily scaled up without any super-advanced tools, it's consistent, and it's very robust," said Aleksandra Vojvodic, a SLAC staff scientist with the SUNCAT Center for Interface Science and Catalysis who led the theoretical side of the work.

Storing Sun and Wind Power

Scientists have been searching for an efficient way to store electricity generated by solar and wind power so it can be used any time -- not just when the sun shines and breezes blow. One way to do that is to use the electrical current to split water molecules into hydrogen and oxygen, and store the hydrogen to use later as fuel.

This reaction takes place in several steps, each requiring a catalyst -- a substance that promotes chemical reactions without being consumed itself -- to move it briskly along. In this case the scientists focused on a step where oxygen atoms pair up to form a gas that bubbles away, which has been a bottleneck in the process.

In previous work, Vojvodic and her SUNCAT colleagues had used theory and computation to look at water-splitting oxide catalysts that contain one or two metals and predict ways to make them more active. For this study, Edward H. Sargent, a professor of electrical and computer engineering at the University of Toronto, asked them to look at the effect of adding tungsten -- a heavy, dense metal used in light bulb filaments and radiation shielding -- to an iron-cobalt catalyst that worked, but not very efficiently.

With the aid of powerful computers at SLAC and elsewhere and state-of-the-art computational tools, the SUNCAT team determined that adding tungsten should dramatically increase the catalyst's activity -- especially if the three metals could be mixed so thoroughly that their atoms were uniformly distributed near the active site of the catalyst, where the reaction takes place, rather than separating into individual clusters as they normally tend to do.

"Tungsten is quite a large atom compared to the other two, and when you add a little bit of it, it expands the atomic lattice, and this affects the reaction not only geometrically but also electronically," Vojvodic said. "We were able to understand, on the atomic scale, why it works, and then that was verified experimentally."

Add Metal Atoms, Mix and Gel

Based on that information, Sargent's team developed a novel way to distribute the three metals uniformly within the catalyst: They dissolved the metals and other ingredients in a solution and then slowly turned the solution into a gel at room temperature, tweaking the process so the metal atoms did not clump together. The gel was then dried into a white powder whose particles were riddled with tiny pores, increasing the surface area where chemicals can attach and react with each other.

In tests, the catalyst was able to generate oxygen gas three times faster, per unit weight, than the previous record-holder, Sargent said, and it also proved to be stable through hundreds of reaction cycles.

"It's a big advance, although there's still more room to improve," he said. "'And we will need to make catalysts and electrolysis systems even more efficient, cost effective and high intensity in their operation in order to drive down the cost of producing renewable hydrogen fuels to an even more competitive level."

Sargent said the researchers hope to use the same method to develop other three-metal catalysts for splitting water and also for splitting carbon dioxide, a greenhouse gas released by burning fossil fuels, to make renewable fuels and chemical feed stocks. He and five other members of the University of Toronto team have filed for a provisional patent on the technique for preparing the catalyst.

Future Directions

"There are a lot of things we further need to understand," Vojvodic said. "Are there other abundant metals we can test as mixtures in oxides? What are the optimal mixtures of the components? How stable is the catalyst, and how can we scale up its production? It needs to be tested at the device level, really."

Jeffrey C. Grossman, a professor of materials science and engineering at MIT who was not involved in the study, said, "The work impressively highlights the power of tightly coupled computational materials science with advanced experimental techniques, and sets a high bar for such a combined approach. It opens new avenues to speed progress in efficient materials for energy conversion and storage."

Story Source:

The above post is reprinted from materials provided by **SLAC National Accelerator Laboratory**. Note: Materials may be edited for content and length.

Journal Reference:

- B. Zhang, X. Zheng, O. Voznyy, R. Comin, M. Bajdich, M. Garcia-Melchor, L. Han, J. Xu, M. Liu, L. Zheng, F. P. Garcia de Arquer, C. T. Dinh, F. Fan, M. Yuan, E. Yassitepe, N. Chen, T. Regier, P. Liu, Y. Li, P. De Luna, A. Janmohamed, H. L. Xin, H. Yang, A. Vojvodic, E. H. Sargent. **Homogeneously dispersed, multimetal oxygen-evolving catalysts.** *Science*, 2016; DOI: 10.1126/science.aaf1525

Cite This Page:

[MLA](#)
[APA](#)
[Chicago](#)

SLAC National Accelerator Laboratory. "New catalyst is three times better at splitting water." ScienceDaily. 24 March 2016. <www.sciencedaily.com/releases/2016/03/160324154016.htm>.

Share This Page:

[f](#)
[Twitter](#)
[G+](#)
[in](#)
[+](#)
[Email](#)

Earth & Climate News

March 30, 2016



Lasers from Space Unravel Geological Mystery



2016 Arctic Sea Ice Hits Another Record Low



Ocean Temps Predict US Heat Waves 50 Days out



The Past, Present and Future of African Dust

Latest Headlines

updated 12:56 pm ET

Simulation Shows How Modern Interventions Can Affect Tropical Forests and Indigenous People

Mar. 25, 2016 — Carefully designing government interactions with rural indigenous people is critical for protecting the sustainability of people, wildlife and the ...

[read more »](#)

- > Atmospheric Nitrogen: Loss of Plant Diversity
- > Far Reaching Impacts of Beach Replenishment
- > Better Global Ocean Management
- > Environmental Forecasts Provide Enormous Benefit
- > Desert Mangroves: Major Source of Carbon Storage
- > Greenland Melting Tied to Shrinking Arctic ...
- > GOES-R Satellite: Better Hurricane Prediction
- > Splitting Water Becomes Easier, Cheaper
- > Fitness Means Tolerance to Daily Temp Changes?
- > Modern Interventions Can Affect Indigenous ...

[more stories >](#)

Latest Videos

from news services



Mexican Volcano Spews Column of Gas, Ash



Poland Wants To Log A Big Chunk Of Europe's Last Primeval Forest



Arctic Sea Ice Dips to Record Low: NASA



Raw: Underwater Video of Sunken Navy Tug

[more videos >](#)

See fewer ads and support this site.

Contributor works on millions of sites and all of your devices.

Contributor by Google

Related Stories



Benchmarking Electrocatalysts for Solar Water-Splitting Devices

June 16, 2015 — Efficiently turning sunlight into storable fuels requires catalysts that convert a maximum amount of solar energy into fuel. A lack of standardized analytic conditions and methods has made ... [read more »](#)

Improving the Cost and Efficiency of Renewable Energy Storage

July 17, 2014 — Scientists have developed a method for improving the catalysis of water-splitting reactions used for storing wind and solar energy. The method chemically peels off the outermost surface of a ... [read more »](#)

An Improved, Cost-Effective Catalyst for Water-Splitting Devices

Jan. 8, 2014 — Scientists have created a simple and scalable technique for greatly improving water splitting as a source of clean ... [read more »](#)



Scientists Produce Hydrogen for Fuel Cells Using an Inexpensive Catalyst Under Real-World Conditions

Aug. 23, 2012 — Scientists have produced hydrogen, a renewable energy source, from water using an inexpensive catalyst under industrially relevant conditions (using pH neutral water, surrounded by atmospheric ... [read more »](#)

Ad



Osmometer made in Germany

Fast and effective measuring - competent after sales service! [www.gonotec.com](#)

Strange & Offbeat

PLANTS & ANIMALS

Psychotherapy for Depressed Rats Shows Genes Aren't Destiny



A World Map of Neanderthal and Denisovan Ancestry in Modern Humans



Creation of Minimal Cell With Just the Genes Needed for Independent Life



Moving Microswimmers Using Magnetic Vortices

EARTH & CLIMATE

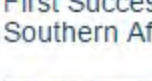


City Birds Are Smarter Than Country Birds



Could Ireland's Ecosystems Cope If We Introduced St. Patrick's Scaly Foes?

First Successful Extraction of Ancient DNA from a Southern African Mummy



Unique Beak Evolved With Tool Use in New Caledonian Crow

FOSSILS & RUINS

Human Ancestors Explored 'out of Africa' Despite Impaired Nasal Faculties



More Ancient Viruses Lurk in Our DNA Than We Thought



The Linguistics of Signifying Time: The Human Gesture as Clock



Solving the Mystery of the Tully Monster

PENN STATE | ONLINE

Make a world of difference – apply today!

[▶ LEARN MORE](#)

In Other News

from NewsDaily

SCIENCE

U.S. firms target investment in Israeli cannabis R&D

Sanofi poaches AstraZeneca scientist as new research head

Giant rats to sniff out tuberculosis in Tanzania, Mozambique prisons

Stripped-down synthetic organism sheds light on nature of life

HEALTH

FDA panel backs Acadia drug for psychosis linked to Parkinson's

Bloomberg, others give \$125 million for immunotherapy cancer research

Obama calls for more funds, new attitude to fight opioid epidemic

Brazil's confirmed, suspected microcephaly cases rise to 5,235

ENVIRONMENT

Probe of Exxon's climate change disclosures expands

Terminix to pay \$10 million for pesticide misuse: Justice Department

U.S. FTC sues Volkswagen over diesel advertising claims

Alaska volcano erupts with massive ash cloud, diverting flights

TECHNOLOGY

Top computing awards show growing importance of cybersecurity

Foxconn to overhaul Sharp management after planned takeover: Yomiuri

Amazon agrees to pay fine for wage law violation by contractor

Apple's encryption battle with United States still alive in Brooklyn

[Print](#)
[Email](#)
[Share](#)

Free Subscriptions

Get the latest science news with ScienceDaily's free email newsletters, updated daily and weekly. Or view hourly updated newsfeeds in your RSS reader:

[Email Newsletters](#)

[RSS Feeds](#)

Follow Us

Keep up to date with the latest news from ScienceDaily via social networks:

[f](#) Facebook

[Twitter](#)

[Google+](#)

[in](#) LinkedIn

Mobile Apps

Get the latest news from ScienceDaily via our free mobile apps, available for download on the following platforms:

[iPhone/iPad](#)

[Android](#)

Have Feedback?

Tell us what you think of ScienceDaily -- we welcome both positive and negative comments. Have any problems using the site? Questions?

[Leave Feedback](#)

[Contact Us](#)