

Renewable energy: artificial leaf can make our life better.

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Анотація

Аналіз створення "штучного листа", який перетворює сонячне світло в синтетичне паливо.

Ключові слова: відновлювальна енергія, «зелена енергія», штучне листя, синтетичне паливо.

Abstract

Analysis of creating an "artificial leaf" that converts sunlight into synthetic fuel.

Keywords: renewable energy, green energy, artificial leaf, syngas.

Introduction

Scientists made plenty of progress with sustainable energy in recent years, but there's still a lot of work left to do. Now, there's encouraging news on the development of an 'artificial leaf' that could lead to the production of truly 'clean' synthetic fuel.

In this case, the key step towards that achievement is the sustainable production of syngas (or synthesis gas), a mixture of hydrogen and carbon monoxide. Currently, syngas is widely used in the production of various fuels, drugs, plastics, and fertilizers; it can be made in a number of ways, but usually involves the leftover products from coal or petroleum based materials. Thus, the final product isn't always carbon neutral.

Research results

The carbon-neutral device sets a new benchmark in the field of solar fuels, after researchers at the University of Cambridge demonstrated that it can directly produce the gas – called syngas – in a sustainable and simple way.

Rather than running on fossil fuels, the artificial leaf is powered by sunlight, although it still works efficiently on cloudy and overcast days. And unlike the current industrial processes for producing syngas, the leaf does not release any additional carbon dioxide into the atmosphere

Syngas is currently made from a mixture of hydrogen and carbon monoxide, and is used to produce a range of commodities, such as fuels, pharmaceuticals, plastics and fertilizers.

"You may not have heard of syngas itself but every day, you consume products that were created using it. Being able to produce it sustainably would be a critical step in closing the global carbon cycle and establishing a sustainable chemical and fuel industry," said senior author Professor Erwin Reisner from Cambridge's Department of Chemistry, who has spent seven years working towards this goal.

The leaf mimics the photosynthesis we see in plants, combining incoming light, water and carbon dioxide with a cobalt catalyst called perovskite. At the other end you get hydrogen and carbon monoxide, which can then make syngas.

While the efficiency of the machine is low at the moment, it should be possible to improve that with further research. It's the unique combination of materials and catalysts, the scientists say which puts their system ahead of similar devices.

"You are not limited to using this technology just in warm countries, or only operating the process during the summer months," says chemist Virgil Andrei from the University of Cambridge.

Reisner and his colleagues are inspired by photosynthesis – the natural process by which plants use the energy from sunlight to turn carbon dioxide into food.

On the artificial leaf, two light absorbers, similar to the molecules in plants that harvest sunlight, are combined with a catalyst made from the naturally abundant element cobalt.

When the device is immersed in water, one light absorber uses the catalyst to produce oxygen. The other carries out the chemical reaction that reduces carbon dioxide and water into carbon monoxide and hydrogen, forming the syngas mixture.

As an added bonus, the researchers discovered that their light absorbers work even under the low levels of sunlight on a rainy or overcast day.

That is of course important in those parts of the world where stable electricity or a reliable sunshine supply isn't always guaranteed.

And while renewable power sources like wind and solar are becoming better and better at producing electricity for us, the energy demands of the world go way beyond electricity – heavy transport, shipping, and air travel all need cleaner fuels, which is where this artificial leaf could come in.

In terms of this new research, the team members say they are confident in their catalysts and combination of materials and that bodes well for the future – eventually, syngas might not be needed as an intermediate stage, and the production could proceed straight to carbon-neutral liquid fuel.

Scientists want to make liquid fuel in one step instead of making synthetic gas and then convert it into fuel.

Although great advances are being made in generating electricity from renewable energy sources such as wind power and photovoltaics, Reisner says the development of synthetic petrol is vital, as electricity can currently only satisfy about 25% of our total global energy demand. There is a major demand for liquid fuels to power heavy transport, shipping and aviation sustainably.

Conclusions

Further exploration of this technology will provide the necessary amount of synthetic gasoline in the fields of aviation, shipping, etc. Using this technology, we can reduce our carbon footprint and ensure the sustainable development of humanity in the years to come.

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