

Artificial leaf as mini-factory for drugs

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Credit: TU Eindhoven / Bart van Overbeeke

Using sunlight to make chemical products has long been a dream of chemical engineers. The problem is that the available sunlight generates too little energy to kick off reactions. However, nature is able to do this. Antenna molecules in leaves capture energy from sunlight and collect it in the reaction centers of the leaf where enough solar energy is present for the chemical reactions of photosynthesis.

Light capture

The researchers used relatively new materials known as [luminescent solar concentrators](#) (LSC's), which are able to capture sunlight in a similar way. Special light-sensitive molecules in these materials capture a large amount of the incoming light that they then convert into a specific color that is conducted to the edges via light conductivity. These LSCs are often used in combination with solar cells to boost the yield.

Thin channels

The researchers, led by Dr. Timothy Noël, incorporated very thin channels in a silicon rubber LSC through which a liquid can be pumped. In this way, they were able to bring the [incoming sunlight](#) into contact with the molecules in the liquid with high enough intensity to generate chemical reactions.

While the reaction they chose serves as an initial example, the results surpassed all their expectations, and not only in the lab. "Even an experiment on a cloudy day demonstrated that the chemical production was 40 percent higher than in a similar experiment without LSC material," says research leader Noël. "We still see plenty of possibilities for improvement. We now have a powerful tool at our disposal that enables the sustainable, sunlight-based production of valuable chemical products like drugs or crop protection agents."



Even with the naked eye the amount of light captured by the ‘mini-factories’ is visible, lit up bright red. The ‘veins’ through the leaves are the thin channels through which liquid can be pumped. The start products enter the one channel, light causes the reactions and the end product comes out via the other channels. Credit: TU Eindhoven / Bart van Overbeeke

Paracetamol on Mars

For the production of drugs, the system offers a lot of potential. Current [chemical reactions](#) for producing drugs require toxic chemicals and a lot of energy in the form of fossil fuels. By using visible light, the same reactions become sustainable, cheap and, in theory, countless times faster. But Noël believes it should not have to stop there. "Using a reactor like this means you can make drugs anywhere, in principle, whether malaria drugs in the jungle or paracetamol on Mars. All you need is [sunlight](#) and this mini-factory."

More information: A leaf-inspired luminescent solar concentrator for energy efficient continuous-flow photochemistry, *Angewandte Chemie Int. Ed.* 21 December 2016. [DOI: 10.1002/anie.201611101](https://doi.org/10.1002/anie.201611101)

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