Algae wrapped in droplets improves efficiency of artificial photosynthesis

In our quest for the most sustainable, most renewable sources of energy, humanity continues to look to nature for inspiration. One of nature's most efficient energy systems is photosynthesis, which is how plants convert sunlight, water, and carbon dioxide into chemical energy to fuel themselves. Harnessing the power of photosynthesis is one of the key aspirations of renewable energy research today, and thanks to scientists from Singapore's **Nanyang Technological University** (NTU), we are one step closer to making **artificial photosynthesis technology** commercially viable.

Artificial photosynthesis' low-efficiency level is one of the main obstacles that scientists working on this kind of renewable energy face today.

"Artificial photosynthesis is not as efficient as solar cells in generating electricity," says study lead Chen Yu-Cheng. "However, it is more renewable and sustainable. Due to increasing interest in environmentally-friendly and renewable technologies, extracting energy from light-harvesting proteins in **algae** has attracted substantial interest in the field of bio-energy."

According to the NTU scientists, solar panels can convert sunlight to energy at efficiencies of around 20 percent, while artificial photosynthesis technologies are currently running at efficiencies of around four or five percent. However, NTU's scientists have released a study demonstrating how encasing algae in very small droplets can boost its natural energy harvesting abilities by up to three times.

The study revolves around phycobiliproteins, which are the proteins that absorb light within algae cells. The scientists were successful in boosting the cells' ability to transform captured light into energy by enveloping the red algae in tiny liquid crystal droplets that are 20 to 40 microns in size.

"The droplet behaves like a resonator that confines a lot of light," Chen explains. When the light hits the droplet, the curved edges cause an effect that the researchers call "**whispering-gallery mode**," which is when the light travels around the perimeter of the droplet and is then trapped inside for longer. "This gives the algae more exposure to light, increasing the rate of photosynthesis. A similar result can be obtained by coating the outside of the droplet with the algae protein too. By exploiting microdroplets as a carrier for light-harvesting biomaterials, the strong local electric field enhancement and photon confinement inside the droplet resulted in significantly higher electricity generation."

In comparison with an untreated algae protein, algae protein encased in these crystal droplets was able to generate two to three times more energy. The droplets may also be produced in larger forms so that they can surround algae that are growing in bodies of water, which could potentially become floating **power generators**.

This technology might also improve the performance of organic **solar cells** by trapping and dispersing the light for more effective energy generation.

The next step for the NTU team is to see whether the droplets can be produced in bulk at a reasonable cost.

Source study: *ACS Applied Materials & Interfaces*—**Light-harvesting in biophotonic optofluidic microcavities via whispering-gallery modes**