Developing a Biologically Based Artificial Leaf to Filter and Transform Carbon Dioxide Emissions into Oxygen via Photosynthesis

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Every year, over 38 billion tons of carbon dioxide are released into the atmosphere due to various human related activities. With excess CO2 production, many critical problems arise such as global warming, higher levels of air pollution, and ocean acidification. Although biological plants can filter large amounts of carbon dioxide, arable land which may not always be available is required to complete such process. Instead of depending on biological plants, the researcher proposed the idea of developing a fully artificial leaf which mimics the process of photosynthesis. Such device could act as a stable source for oxygen and a practical method to reduce carbon dioxide emissions. It was hypothesized that developing a cyto-compatible calcium alginate hydrogel to encapsulate and support the structures of cyanobacteria would result in a biomimetic leaf. In this project, a hydrogel solution containing sodium alginate, a cell culturing bio reagent, and cyanobacteria was created and polymerized to develop an artificial leaf. Data collection tests involved placing the artificial leaves into a sealed tank to measure the oxygen production rate and a concentrated carbon dioxide environment to measure the CO2 filtration rate. Results showed that the artificial leaves filtered 98% (4,900 ppm) of the carbon dioxide released into the tank in under 8 minutes and produced over 3,000 ppm of oxygen. Since cyanobacteria are known to produce stable amounts of hydrogen, for future applications the researcher is looking towards engineering the artificial leaf to extract large amounts hydrogen to use as biofuels.

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