

Creating a Cost-Efficient Water Soluble Carbon Capture System for CO₂ Emitting Vehicles to Increase Biofuel Production Efficiency

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In 2015 alone the United States released 6,587 Million metric tons of CO₂ gas into the atmosphere(EPA) accounting for 14.3% of global CO₂ emissions and giving the nation one of the highest emissions per capita of any nation. This release of CO₂ leads to global climate warming and a plethora of impacts threatening the viability of Earth itself. The researcher focused on creating a biomimetic system using the carbonic anhydrase enzyme to combine CO₂ and H₂O into carbonic acid that would transfer the CO₂ into a higher density liquid form. Previously, the approach to solving the problems with carbonic anhydrases, such as heat and flue gas stability, have been immobilizing it to a surface or material which can often be toxic and extremely expensive. By instead covalently coupling the CA enzyme through EDC crosslinking to carbon quantum dots we created a new biosafe method of hydrating CO₂ post-combustion in order to facilitate algae biofuel growth. Through this, we create a system to facilitate a decrease in CO₂ emissions from combustion-based power plants while also increasing algae biofuel growth by increasing the CO₂ concentration in the growth medium via the CO₂ absorbed. Uv-Vis, FTIR and fluorescence spectroscopy were all used to identify the enzyme conjugate and ensure that the enzyme was truly bound to the carbon dot. A wilbur-anderson activity assay determined that the conjugate created was more efficient than the standard enzyme in solution, while also increasing temperature stability. Using this nanostructure a highly efficient, temperature resistant and cost-effective enzyme conjugate was made that could be deployed into power plants in order to reduce CO₂ emissions and then use that trapped CO₂ to increase biofuel growth efficiency.

Awards Won:

ASU Rob and Melani Walton Sustainability Solutions Service: Award of \$1,000

Florida Institute of Technology: Full Tuition Presidential Scholarship

Arizona State University: Arizona State University Intel ISEF Scholarship