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

Alagarsamy, Satya (School: American Heritage School)

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 though 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