Energy of Life: Colored Bioluminescent Concentrator for Enhanced Photovoltaic Performance

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The purpose of this experiment was to test how a colored bacteria-based bioluminescent solar concentrator can be used to enhance the power output of photovoltaic cells. We hypothesized that if red bioluminescent bacteria are applied on the surface of glass block attached to a solar cell, the greater light intensity caused by the activation of the luciferase enzyme in the bioluminescent bacteria in conjunction to light concentration by the glass and the longer red wavelengths will directly increase the power output by a large factor. The experiment consisted of four trials, with each trial containing one control concentrator attached to a solar cell and four concentrators applied with different colored bioluminescent E. coli (red, yellow, green, and blue) attached to a solar cell. The test was conducted for 1.5 hours under simulated daylight conditions and 1.5 hours in the dark, with 15-minute test intervals. The power (wattage) of each recording was calculated by multiplying voltage and current, and these calculated values were used to compare the control and bacteria applied solar cells. The hypothesis of the experiment was accepted. On average, the red bioluminescent bacteria increased the power output of the photovoltaic cells by approximately 78.43% in the day simulation and by 339.1% in the night simulation. These findings suggest that the enhancement of photovoltaic cell performance using red bioluminescent bacteria on a luminescent solar concentrator would allow for greater amounts of energy to be output by real-world solar panels.

Awards Won:
Fourth Award of $500
Sigma Xi, The Scientific Research Honor Society: Second Physical Science Award of $1,000