Comparison of Organized and Randomized Multilayer Films

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According to a recent study, 1/3 of the world population has little or no power and is not connected to the world power grid. However, enough solar energy hits the earth in 1.5 hours to power the world for an entire year. Dye-sensitized and quantum-dot-sensitized solar cells provide efficient alternatives to traditional cells. The engineering goal was to build the optimal cell with high power output and reduced overheating. The cells were blueberry juice, chlorophyll, berry-then-chlorophyll, chlorophyll-then-berry, mixed berry-and-chlorophyll sensitized, and 560nm, 650nm, 750nm, 560nm/650nm, 650nm/750nm, 560nm/750nm, and 560nm/650nm/750nm mixed quantum-dot-sensitized. Power output was measured with a multimeter on sunny days (solar insolation>350W/m2) with n=100 for dye-sensitized and n=30 for quantum-dot-sensitized. UV-Vis spectra were taken to compare absorbance peaks and performance. An ANOVA+Scheffe post hoc showed a significant difference ($p<0.05$) between all groups except between the berry control and the berry-then-chlorophyll cell (layers were not in increasing energies). However, mixed-layer cells had the greatest power output (0.5mW). This supports that while layer order matters, non-distinct single layers are most effective. When three quantum dots were mixed, there was no significant increase in power because 650nm is a solar emission low. To optimize harvest, only emission peaks and infrared quantum dots should be used. 750nm quantum-dot-sensitized cells had outputs similar to those for the sun’s peak emission, 560nm, suggesting that infrared quantum dots reduce overheating. Finally, quantum-dot-sensitized cells are improved with deposition in an electrostatic field; the fill factor is increased to 0.7123, which is greater than that of conventional cells.

Awards Won:

First Award of $5,000