Fun in the Sun! Increasing Grätzel Cell Efficiency Using Diatomaceous Earth

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In 2013 approximately 36 gigatonnes of carbon dioxide was released into the atmosphere – intensifying the greenhouse effect and contributing to global warming and rapid climate change. As demand for renewable energy sources increases, solar energy offers an inexpensive, sustainable, renewable energy substitute to fossil fuels. This research investigated the effect of diatomaceous earth (fossilized remains of prehistoric sea creatures) on the efficiency of a Grätzel cell (dye sensitized solar cell). These cells are an alternative to the silicon cells given their effectiveness in ambient light conditions. The cells are low-cost, lightweight and can be made in a flexible form for use in portable devices and translucent materials such as windows. Grätzel cells utilize organic dyes that mimic photosynthesis in plants, nanostructured oxide (TiO2), and an electrolyte solution to produce electricity. Six independent variables were tested to evaluate their impact on the level of electrical energy produced and the overall efficiency of the cell including the amount of diatomaceous earth solution applied and the type of solar cell evaluated. Results indicated that a Grätzel cell with the addition of diatomaceous earth, anthocyanin pigments, and a 50% TiO2 to diatomaceous earth ratio was the optimal configuration, which increased cell voltage by 7.1 times compared to a standard Grätzel cell. A regular Grätzel cell produced 0.3μW and the diatomaceous earth cell produced 2.7x10^3 μW, resulting in a power conversion efficiency of 2.4x10^-4% and 2% respectively. The results show a dramatic increase in the efficiency and power output of the diatomaceous earth Grätzel cell.

Awards Won:

Third Award of $1,000