The Energy Generation Efficiency and Storage Capability of a Novel Dye-Sensitized Solar Cell

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Dye-sensitized solar cells (DSSC) can convert visible light into electricity through cell sensitization. As they’re cheaper and more environmentally friendly to produce than silicon photovoltaic cells, DSSC are considered to be the most promising third generation photovoltaic cells, despite their lower efficiency. It was hypothesized that with the innovatively designed DSSC using titanium dioxide paste instead of a thin film of titanium dioxide to allow for higher electricity generation, the efficiency of the DSSC would be greatly improved. The novel DSSC was created using an indium tin oxide (ITO) glass coated with a paste-like mixture of titanium dioxide, electrolyte (iodine tincture or decolorized iodine), dye (blackberry or raspberry), and acid (white vinegar or dilute nitric acid), and topped with a graphite plate cover. Each DSSC was sealed with epoxy resin within 15 minutes of completion. To measure its energy generation efficiency, the solar energy input was measured with a light sensor. The currentvoltage curve (I-V curve) and the power output were measured with a current sensor, a 16-bit programmable analog digital converter (ADC), and multimeters. The novel DSSC produced over 150% higher efficiency than the conventional DSSC under direct sunlight, as well as higher power storage capability. By applying the novel design to current DSSC production, the efficiency of DSSC may reach up to 24%, comparable to that of silicon photovoltaic panels (i.e.,18 - 22%). With this novel design, the commercialization of DSSC is more feasible, thereby allowing for a more sustainable future.

Awards Won:
Office of Naval Research on behalf of the United States Navy and Marine Corps: The Chief of Naval Research Scholarship Award of $15,000
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: NOT TO BE READ -- $200 cash prize for each Enrichment award recipient
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: Mawhiba Universal Enrichment Program awards (and a $200 cash prize)