CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0614

Project Title
The Synthesis of Quantum Dots for Application in Solar Cell Efficiency

Abstract

Objectives/Goals
The goal of my project is to synthesize quantum dots and apply them to solar cells to make them more efficient.

Methods/Materials
ZnSe quantum dots, composed of Zinc Acetate, Selenium, distilled water, ethanol glycol, and hydrazine hydrate were synthesized first. The solution was cooked in a water bath for eight hours, then rinsed with anhydrous ethanol and distilled water. The CdSe quantum dots required two precursors. The TOPSe precursor contained Selenium, octadecene, and trioctylphosphine, which was mixed until clear. The Cd precursor was a mixture of CdO, oleic acid, and octadecene, cooked in a heating mantle until the solution reached 225 degrees Celsius. Then 1ml of the TOPSe precursor was added and 1ml samples of the mixture were removed at five second intervals. These samples were mixed with ethyl alcohol in a centrifuge to remove excess liquid. Hexanes were then added to create the final CdSe quantum dot solution. For the application to the solar cells, the ZnSe quantum dots were also mixed in with hexane. The conductive glass used was one inch squares. A TiO2 slurry was created by mixing TiO2, distilled water, and TritonX-100 until the consistency of paint. This was then applied in an even coat to the conductive side of the glass and allowed to air dry before sealing over a bunsen burner. On other pieces of glass, graphite was applied to the conductive side. The quantum dots were applied by pooling the hexane quantum dot solution on the TiO2 and allowing the hexanes to evaporate, thus leaving the quantum dots. Each quantum dot square was clamped together with a graphite square. Before testing under an overhead light, an iodine solution composed of KI, Iodine, and ethylene glycol, was put between the two pieces of glass.

Results
The ZnSe quantum dots were determined unsuccessful. The CdSe quantum dots were much more successful considering they fluoresce under a UV light, as described by many scientific articles. For the application to the solar cells, the ZnSe quantum dots were not successful, having approximately the same potential energy than the test cell which only had TiO2, graphite, and the iodine solution. The CdSe quantum dot solar cells nearly doubled what the test cell produced.

Conclusions/Discussion
The quantum dot application to the solar cells was a success and has great potential for future consumer cell application.

Summary Statement
My project focused on improving solar cell efficiency through the application of quantum dots.

Help Received