Photovoltaic Nano-crystal Energy Generation

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Research Question
How can photovoltaic technologies be used in order to engage in large-scale renewable energy generation?

Situation
Photovoltaic technology relates to generating electrical power by converting solar radiation into current using semiconductors. In fact, it does so with almost no detrimental environmental impact. If photovoltaic technologies are very usable forms of, why is it that they are not being implemented on a large scale? The main reason is that the cost of installation remains high which is why many pioneers in the energy generation industry call for the reduction of costs so that utilization can be expanded into other markets. Dr. Sethi highlights, in his article “Cost Boundary in Silicon Solar Panel” emphasizes the fact that for such applications to be feasible the cost of producing and installing the technologies must be reduced [1]. While nations such as Germany and Spain lead the race in photovoltaic energy generation, most other nations’ photovoltaic energy generation market remains poorly developed.

Evaluation
The use of photovoltaic technologies can considerably reduce the environmental impacts of energy generation. However, through the wide spread of photovoltaic technology, particularly photovoltaic nanocrystals, the cost of the technology will be significantly reduced. On the other hand, photovoltaic nanocrystals have traditionally been known to be inefficient in converting sunlight into electrical energy, but now due to the addition of ligands this shortcoming has been substantially eliminated. Finally, the use of cadmium selenide in order to fabricate the ligands has been suspected to cause impairments in the human nervous and immune systems, as such the use of this particular compound should be revisited.

Problems
- High Cost
- Complexity of production process
- Inefficiency in energy generation

Solutions
- Photovoltaic nanocrystals
- Ligands

Table 2 - Binding energies of ligands applied to a Zinc based surface

By adding different ligands various levels of binding energies were achieved. In the case of Zinc Sulfide, it attained a lower binding energy compared to that of Cadmium Sulfide. This would significantly reduce heating costs as the use of ligands can be tailored to match the prospective applications of each batch of nanocrystals separately. Another example of ligands includes Lead Selenide which yielded a much greater dispersity and homogeneity in nanocrystal size and formation.

Table 3 - Lead Selenide nanocrystal absorption spectra

In Figure 3, the ligand was utilized as the sole “infrared absorbing material” [2]. Despite its miniaturized size, it managed to display superior absorption properties throughout different regions where no electron states exist, or bandgaps, showing some of the potential that ligands have.

Table 4 - Percentage improvement of nanoparticle distribution

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References