Effect of anthocyanins on a dye-sensitized solar cell

[redacted]

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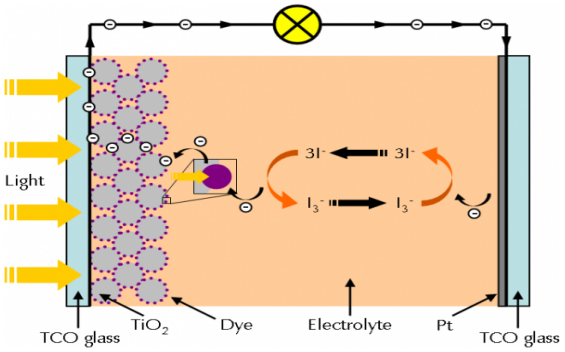
Electricity has become an indispensable part of our lives. Electricity has dramatically changed and enriched our lives. However, the electricity we generate is now accelerating global warming. Instead of thermal power generation, which is currently the mainstream method of power generation, attention is being focused on power generation methods that do not emit greenhouse gases such as carbon dioxide and methane, and power generation methods that use renewable energy sources such as hydropower, wind power, and geothermal power, which do not suffer from resource depletion, and are actually being used. Photovoltaic power generation is one such type of power generation method. In this research, we focused on dye-sensitized solar cells, which are often made from fruit juices containing dyes. We thought that the amount of electricity generated would be even greater if we used dyes in a more pure state, and conducted various experiments. As a result, we found that the amount of power generated by blueberry juice was greater than that of anthocyanin-based batteries. The main pigment in blueberries is known to be cyanidin, but there are many different types of anthocyanins, and it would be worthwhile to investigate the amount of power generated by each type of anthocyanin.

1 Background

Recently, more and more households have installed solar panels on their roofs or on the roofs of their flats to generate their own electricity, but the solar panels we often see are called silicon solar cells, which have excellent conversion efficiency and durability. However, they are expensive because they use silicon, which is in very high demand, and they may not be able to produce electricity in all weathers. We have also learned from previous research that it is possible to make solar cells using a familiar dye.This is called dye-sensitized solar cells.This energy can be made of conductive glass coated with dye, titanium dioxide IV, and carbon. The characteristics of these cells are that they are inferior to silicon solar cells in terms of conversion efficiency and durability, but they can be manufactured at low cost and low energy, and the amount of power generated per unit cost exceeds that of silicon solar cells.
Next is how dye-sensitized solar cells generate electricity.
First, the light hits the pigment and becomes high in energy.
Then this pigment emits electrons to generate an electric current.
The electrons then dissolve into the solution.
Finally, the electrons return to the dye and cause the current to continue to flow.



In the previous research, Researchers made this energy using Fruit juice containing anthocyanins as pigments as it is and experimented. Anthocyanins can be used for dye-sensitized solar cells.
However, the result obtained by this is only the result of fruit juice, not the effect of anthocyanin alone, which is a pigment contained in fruit juice. Therefore, we decided to research the effect of anthocyanins alone to see if the pigment alone can generate electricity. We thought what affects dye-sensitized solar cells is only anthocyanin and Solar cells using juice from blueberries generate the same amount of electricity as solar cells using anthocyanins extracted from blueberries.

2 material and method

1,Methanol is used to extract anthocyanin.However,it's a dangerous material to use. Instead of methanol, we focused on ethanol,

which has a similar structure. Ethanol is a substance that is very close to our lives.

2,We varied the ratio of solutions as shown in tqble1 and soak silica gel dipped in blueberry juice to determine the percentage of solution that most easily separates the dye from the blueberry juice.

3,We made a solar cell using a glass with no coating, a glass with blueberry juice directly on it, and a glass with anthocyanin extracted using the solution obtained in the previous experiment.

4,We shined a projector on the solar cells we made and 2) generate electricity, measure the voltage with a multimeter, and compare the results.

5,In order to block out unnecessary light, we covered the experimental apparatus with a box.

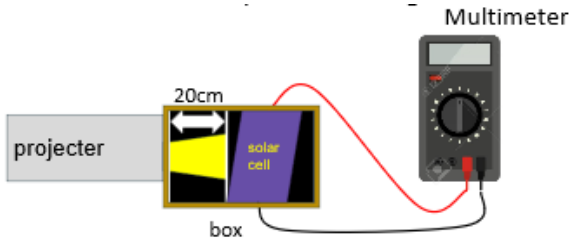
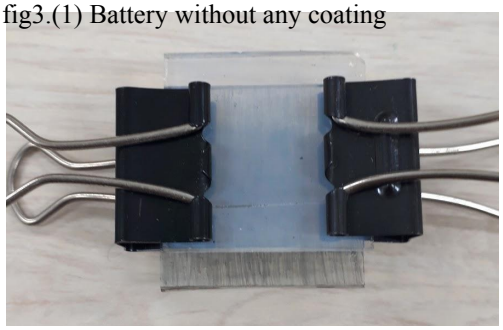


fig 1.Schematic of the experiment

fig2.The actual experiment

Also, these are the actual solar cells that I made.

fig3.(1) Battery without any coating



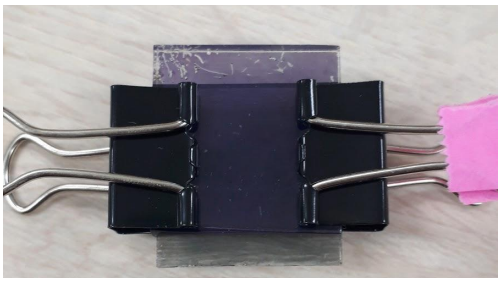


fig4.(2)Batteries coated with blueberry juice

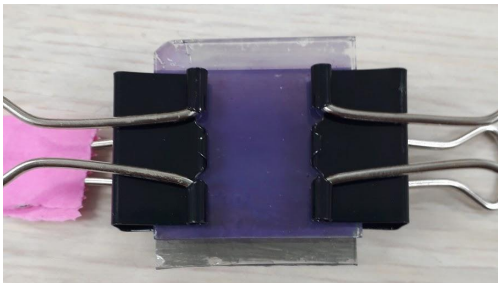


fig5.(3)Battery coated with extracted anthocyanins

3 Results and discussion

(1)We investigated the best proportion of water ethanol and acetic acid to separate dye by changing the amount of water and acetic acid.

	Methanol	Ethanol	water	acetic acid
1		46	0	4
2		41	5	4
3		36	10	4
4		25	21	4
5	25		21	4
6		13	33	4
7		6	40	4
8		0	46	4

Table1. proportion of water ethanol and

acetic acid

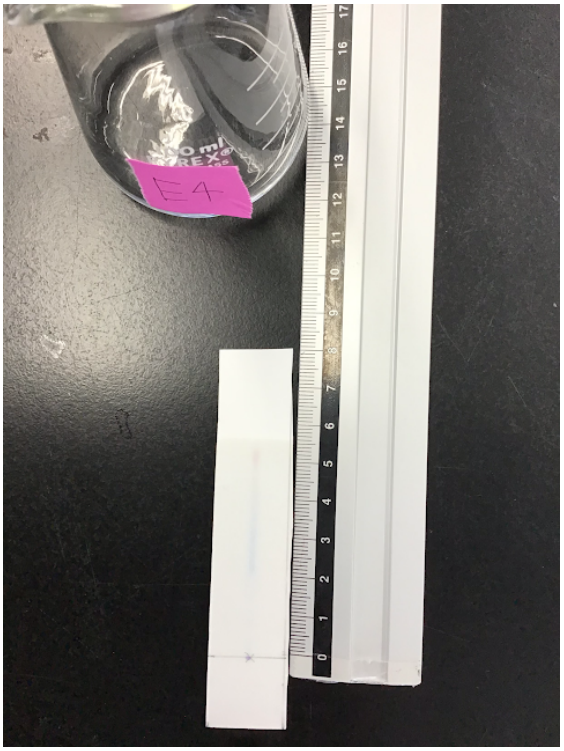
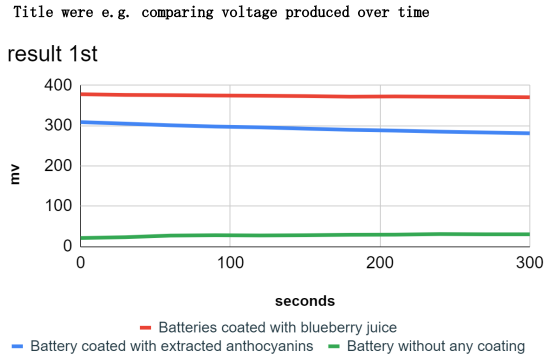
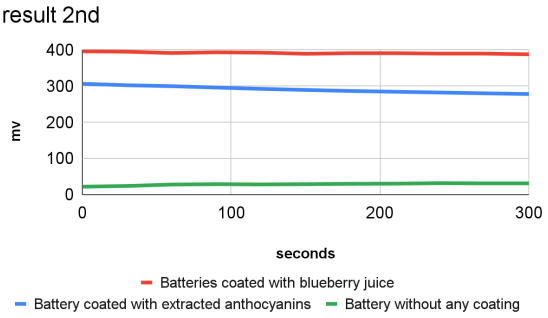


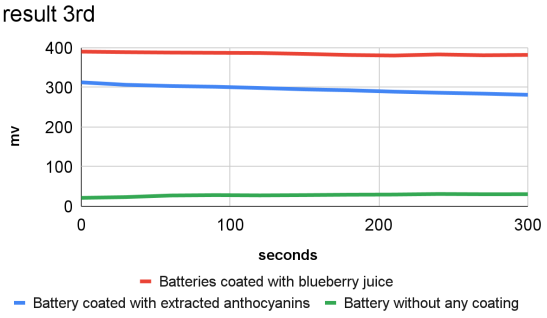
fig6 The separation of No.3

This time,we used ethanol instead of methanol because it is a dangerous substance. From these results,we found that the No.3`s proportions were the most separated of any other of them.So,we decided we will use the proportion of solutions at the next experiment.
(Ethanol:water:Acetic acid
=18:5:2)

(2)







Before this experiment,we expected that solar cells using blueberry juice and anthocyanins generation the same amount of electricity.However, the voltage of normal blueberry juice is bigger than that of anthocyanin. From this result, we think there are other substances involved in this reaction. Also, ability of anthocyanin is changed on the way to this experiment. But we can confirm that dye are involved in power generation because the voltage produced by anthocyanin was bigger than that of no dye.

In the future, first, we should confirm that the same results is generated. if we do same experiment again. In this time,we extracted anthocyanins by column chromatography. And we will find out other substances include in blueberry fruit.So,we will be able to find some substances involved in power generation.

4 References

1)Sendai Daisan High School Dye-Sensitized Solar Cells and Anthocyanins 2019\

2) Nanocrystalline Dye-sensitized Solar Cells Appendix

3)Takeshi Terano, Ryuichi Shirado Temperature

and Irradiance Dependence of Dye-Sensitized Solar Cell Properties Kyushu Institute of Technology https://www.jstage.jst.go.jp/article/jceeek/2016/0/2016_206/_article/-char/ja/

4)Hironori Arakawa Dye-sensitized solar cells https://www.jstage.jst.go.jp/article/mukimate2000/11/313/11_313_481/_article/-char