Dye-Sensitised Solar Cells (DSSC)

Student worksheet

In this activity, you will be looking at how solar energy can be used as an alternative energy source, by building and testing your own solar cell. Please read the following instructions carefully and ask your instructor if you have any questions.

Equipment required

Kit per student

- Lab coats
- Safety goggles
- Nitrile gloves

Kit per pair

- Fruit such as raspberries, blackberries, blueberries red dragon fruit (either fresh or frozen and thawed)
- Pestle and mortar
- 30 cm^3 ethanol
- 15 cm^3 distilled water
- 5 cm^3 0.1M ethanoic acid
- Electrolyte solution
- Plastic tweezers
- 250 cm^3 beaker
- 100 cm^3 beaker
- Glass rod
- Tea strainer
- Plastic pipette
- 1 x titanium dioxide-coated glass electrode
- 1 x FTO doped counter glass electrode
- Multimeter with connective wires and alligator clips
- Aluminium foil
- Variety of light sources such as desk lamp, torch, mobile phone torch (including some UV sources)
- 2 x wooden binding clips
- Hot plate

Procedure

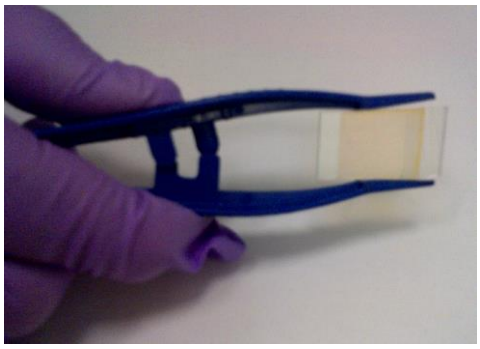
1. Take a handful of berries, mash them to a pulp using a pestle and mortar, and add the pulp to the large 250 cm^3 glass beaker

2. Measure out 30 cm^3 ethanol, 15 cm^3 distilled water and 5 cm^3 ethanoic acid and add to the pulp

3. Place the beaker on a hot plate and stir with a glass rod, while gently heating. Do this until the colour of the liquid turns a deep red. CAUTION: Take care as the hot plate will be hot

4. Using the tea strainer, carefully pour the pulp solution into the small 100 cm^3 beaker. Dispose of the remaining pulp into the waste beaker

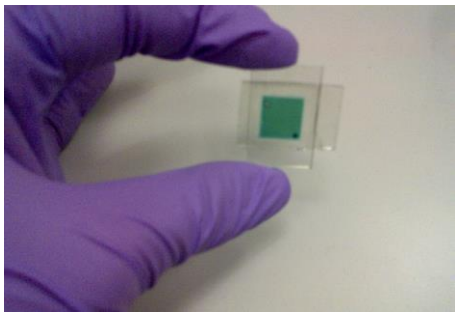
5. Using the tweezers, carefully pick up the titanium dioxide-coated glass electrode BY THE EDGES (see picture below) and place it inside the small beaker containing the pulp solution mixture. It is important to ensure that the coated side of the electrode faces up and is in direct contact with the dye

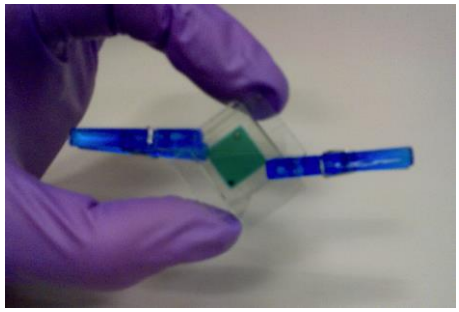


6. Incubate the glass electrode in the fruit mixture for 15 minutes to allow the dye to bind to the electrode

7. Using then tweezers, remove the titanium dioxide-coated electrode from the dye solution. Wash this with a small amount of ethanol to remove the dye solution and gently pat the slide dry with paper towels

8. Take the counter electrode, identify the conductive side and place it on top of the dyed titanium dioxide-coated glass slide, offsetting it by 90° (see image below on left hand side). Clip the two glass electrodes together using the wooden pegs provided (see image below on right hand side)





9. Using a plastic pipette, place 3 drops of electrolyte solution into the join of the electrodes, covering the full surface of the glass slides

10. Connect the cell to the multimeter using the alligator clips and the aluminum foil. The negative terminus (usually black) goes to your dyed electrode and the positive terminus (usually red) to the other electrode. To ensure the electrodes have been connected correctly, check that there is a positive reading on the multimeter for any setting

11. Now you can test your solar cell: place your solar cell under three different light sources, for example a desk lamp, an overhead projector and direct sunlight. Under each light source, you need to record a voltage and a current reading from your multimeter (in volts and milliamps respectively), using the table below

Procedure

We want to know how much power your solar cell can generate. In order to do this, you need to multiply your voltage readings in **volts** and your current reading in **amps** to give a power in **watts**. Record your results in the table below

Light source	Current / mA	Current / A	Voltage / V	Power / W

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Student questions

What are solar cells, and more specifically, what are dye-sensitised solar cells?

Why do we need solar cells?