DYE SENSITIZED SOLAR CELL WITH TULIP DYE

In our research paper we presented history and different types of solar cells, focusing on the dye sensitized solar cell (DSSC) based on the tulip dye. We presented its operation, structure and importance of the individual components. DSSCs are a promising substitute for traditional silicon solar cells. Waste silicon cells are an environmental problem due to their low degradation capability. DSSCs use TiO_2 and ruthenium dyes instead of silicon technology, so they are degradable to a much higher extent.

For the purpose of this research tulip dyes were extracted from red and yellow tulip petals. We wanted to find out which dye is the most suitable for DSSCs, e.g. it absorbs in a wide range of the solar spectrum.

The extracted dyes were applied in DSSCs. The efficiency of these DSSCs was tested. Short-circuit currents as well as open circuit voltages were measured in DSSCs under outdoor conditions, i.e. illumination on a sunny day. The DSSCs with tulip dyes showed promising results.

Under controlled conditions, the dyes with the most suitable absorbance were extracted one more time and their absorbance was measured again. We extracted tulip dyes from yellow and red tulip petals in five different solvents: acetone, water, ethanol, diethyl ether and hexane. Absorbance of the 10 samples of dye solutions was measured using visible light spectrophotometer. Based on the absorbance results, we predicted that DSSCs prepared with the dyes from red tulips in acetone would have the best efficiency. Another characteristic of the acetone samples was that they showed stability, while in water samples dyes started to decompose (after 3 days the decomposition was noticeable).

A second set of DSSCs using the extracted dyes was prepared. We used only the three best performing samples: red tulip dyes extracted in acetone, water and ethanol. The efficiency of these DSSCs was measured. The best performing DSSC was assembled with the tulip dye extracted in acetone. This DSSC was giving 3.1 mA short circuit current and 0.6 V open circuit voltage under the experimental conditions. In comparison to commercially used ruthenium dyes our DSSCs show only 10% efficiency. However, DSSCs with tulip dyes efficiency could be improved by better sealing of the cells. On the other hand, natural dyes could be much cheaper than ruthenium ones (e.g. the dyes from roses used in perfume industry).