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參展科別	**物理與太空科學科**
作品名稱	**Fabrication and Characterization of Dye-Sensitized Solar Cells Using Bixa orellana Seeds and Basella alba Leaves**
得獎獎項	**四等獎**

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ABSTRACT OF EXHIBIT
TAIWAN INTERNATIONAL SCIENCE FAIR

Dye-sensitized solar cells (DSSCs) have cheaper and easier means of fabrication compared to the currently used solar cells, which are mostly silicon-based, so DSSCs are developed for a prospect of solar energy accounting for a higher percentage in the world's total energy production, which is currently 0.1%. However, compared to their inorganic counterparts, their efficiencies are low, and the search for a dye that will maximize the potential of DSSCs is still ongoing.

The aim of this study is to be able to evaluate the absorption range in the solar spectrum of dyes extracted from *Basella alba* leaves and *Bixin orellana* seeds, and of dyes resulting from the mixture of both extracts, using UV-Vis Spectrophotometer, with the objective of increasing the absorption; to be able to fabricate functional DSSCs from the individual and mixed dyes; and to be able to evaluate the different conversion efficiencies of the DSSCs of the individual and mixed dyes using Linear Sweep Voltammetry, with the aim of increasing the conversion efficiency due to a wider absorption range.

B. alba leaves and *B. orellana* seeds were extracted using soxhlet extraction. The clean extracts were mixed in different proportions, and were characterized using UV-Vis Spectrophotometer.

The two individual dyes together with two proportions of the mixed *B. alba*:*B. orellana* dyes, 1:1 and 2:1, were then incorporated into DSSCs. In the fabrication of DSSCs, twelve plates of Fluorine doped tin oxide were coated with titanium dioxide (TiO_2) using spray pyrolysis. They were sintered and scraped, and were afterwards immersed in the four dyes for four days. Platinum plates were placed on top, and iodine-triiodide couple electrolyte was introduced via capillary action. The sealed DSSCs were subjected to Linear Sweep Voltammetry under dark and illuminated conditions, using a sun simulator.

Results from the UV-Vis spectrophotometry showed that mixing the dyes had increased the absorption range of the individual dyes, although not superpositionally, and that the 2:1 mixed dye has the most potential. Being incorporated into DSSCs, the dyes, including the mixed ones, have successfully converted solar energy into electrical

energy, as shown by the significance in conversion efficiencies under dark and illuminated conditions. However, despite the increase in the absorption range, neither of the mixed dyes have shown a higher conversion efficiency than the individual ones, which can be accounted for a possible weaker interaction between the two dyes and the TiO_2, resulting to lower efficiencies.

The study has been able to obtain and characterize dyes from *B. orellana* seeds and *B. alba* leaves and has been able to incorporate the dyes into DSSCs. With the wider absorption range of the mixed dyes, the study has been able to confirm the possibility of the dyes to maximize the potential of DSSCs, as shown by the successful conversion of solar energy into electrical energy of all fabricated DSSCs, including those of mixed dyes. If the possible problem with the dye-dye as well as the dye-TiO_2 interactions could be solved, the possibility of much higher conversion efficiencies could be expected.

評語

This work studied the performance of dye-sensitized solar cells using natural dye from vegetable or fruit. Natural dye has the advantage of abundance and low costs. The authors have tried several types of dye and performed many detailed measurements. The work is complete and interesting to researchers in Solar energy. Some natural dyes have achieved efficiencies near 3%. If the author can reach this efficiency, the work can improve its impact.