

Laboratory Preparation of the Components of a Dye-Sensitized Solar Cell

Ezinna Lucky Efurumibe[1], Anyalewechi Daniel Asiegbu[2] and Michael Onuu[3]
1. Physics Department, College of Natural and Physical Sciences, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.
2. Physics Department, College of Natural and Physical Sciences, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.
3. Physics Department, University of Calabar, Calabar
efurumibeezinna@yahoo.com

Abstract
In this laboratory preparation of the components, the solutions of some of the components of the cell were prepared. This was done (in some cases) after measuring out certain amount of the chemicals. For example for the TiO_2, 6grams of the powder was first weighed, after which the solution was prepared. At the end of the laboratory session, a solution (suspension) of TiO_2 was prepared. Afterwards, a solution of anthocynin dye from Momordica Charantia seed was obtained separately.

1. INTRODUCTION

Energy is inevitably the most wanted commodity in the world today. The industrial revolution has increased the quest for energy, particularly energy whose means of production is environmental friendly. Dye-sensitized solar cell is an interesting area of study for many scientists because of its promising features (O'Regan and Grätzel, 1991). Number one feature is that it only needs a little light from the sun to be activated. Number two feature is that its means of energy production is environmentally friendly. It does not require so much capital and technology to fabricate. Before a dye-sensitized solar cell is built/coupled, its components need to be prepared first. Such components include: the anode of the cell, the sensitized dye and the electrolyte of the cell (Abayev *et al*, 2003; Grätzel, 2004). In most cases the preparation requires first of all getting the solution of the components; and by some other processes, the components of the cell can be built. Here we present majorly the laboratory preparation of TiO_2 suspension and anthocynin solution from Momordica Charantia seed. These solutions were prepared in the Chemistry and Biochemistry laboratories of Michael Okpara University of Agriculture, Umudike. The aim of the exercise is to produce a suspension of TiO_2 and a solution of anthocyanin dye.

2. PREPARING THE TiO_2 SUSPENSION

In preparing the TiO_2 suspension, 9ml of nitric acid solution (pH 3.04 in deionized water) was added (at 1ml increment) to 6g of TiO_2 powder in a mortar and grounded (with a pestle) until the powder dissolved in the solution (Fanis, 2010). The grinding was done for about 30 minute after which 3 drops of liquid detergent was added to the solution to make for even coating of the TiO_2 suspension on the conductive glass slides (see fig. 1). After which the solution was stored in a dropper bottle for coating the conductive glass slides.

Fig.1: A digital balance used in measuring 6g of TiO_2 powder

3. PREPARING THE ANTHOCYNIN FROM MOMORDICA CHARANTIA SEED

The organic dye used in staining the coated glass slides was ‘anthocyanin’ obtained from the seed of Momordica Charantia (see fig. 2). The dye was obtained by crushing the redish-yellow seed of the plant (Momordica Charantia) in a mortar with the addition of acetone (see fig. 3). The acetone helped in producing the solution of the dye (Greenwood and Earnshaw, 1984).

Fig.2: A lab scientist preparing the deionized water for the TiO_2 suspension

Fig.3: Preparing the TiO_2 suspension

4. RESULT

At the end of the laboratory exercise, TiO_2 suspension was obtained. This was placed inside a dropper bottle for later use. This suspension was later used to coat some glass slides for the purpose of designing a dye-sensitized solar cell. The next component that was obtained from the laboratory exercise was an organic dye, which was the anthocynin from the Momordica Charantia seed. This anthocynin was used to stain the glass slides (see fig.4), in the course of designing dye-sensitized solar cells.

Fig. 4: Seed of Momordica Charantia

Fig. 5: Grinding the Momordica Charantia seed

5. CONCLUSION

Working with chemicals in the laboratory is a wonderful experience, particularly when the aim is to build a physical device. Dye sensitized solar cell, as was said in one of our papers is a new research area; an area for prospective researcher in the field of Physics and Engineering (Efurumibe *et al*, 2012). It our belief that one day a good organic dye will be discovered which would be capable of boosting the efficiency of dye-sensitized solar cell up to 80% at least. Nevertheless for the study at hand, the aim of the laboratory exercise was achieved: A suspension of TiO_2 was obtained. Also was obtained is a solution of anthocynin dye, for design of a dye-sensitized solar cell.

6. ACKNOWLEDGEMENT
I would not forget the following persons: Uchenna Ariwa (of Biochemistry Department), Kanu I. Kalu (of Chemistry Department), Solomon Nwadinobi (of Chemistry Deparment) and Ngozi Ukanwaolu (Physics Department) for their contributions towards the realization of the aim of this work. They helped in providing the deionized water, nitric acid solution and relevant apparatuses for the work.

REFERENCES
Abayev, I., Zaban, A., Fabregat-Santiago, F and Bisquert, J. (2003). Electronic Conductivity in nanostructured TiO_2 films permeated with electrolyte, Physica Status Solidi (a) 196, pp 4-6

Efurumibe, E.L., Asiegbu, A.D. and Onuu, M.U. (2012). Mathematical Modelling of Electron Transport through the Anode (TiO_2) of a standard dye-sensitized solar cell, Asian Journal of Applied Sciences, pp 33-44

Fanis, L. (2010). Nanocrystalline solar cell kit Recreating Photosynthesis, ICE publication, pp52

Grätzel, M. (2004). Conversion of sunlight to electric power by nanocrystalline dye-sensitized solar cells, Journal of photochemistry and photobiology A: Chemistry, 164 (1): 3-14

Greenwood, N., Earnshaw, A. (1984), Chemistry of the Elements, Oxford: Pergamon, pp. 1117–1119, accessed online on 16/07/2011 from: http://webcache.googleusercontent.com

O'Regan, B. and Grätzel, M. (1991). A low cost, high-efficiency solar cell based on dye-sensitized colloidal TiO_2 films, Nature 353, pp 737-739