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Design and Fabrication of Novel Front Electrode to Improve Photovoltaic Performance of Dye Sensitized Solar Cells

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Introduction

As a cheap alternative to fossil fuel, dye sensitized solar cells (DSSCs) still have to be improved. In achieving this, charge transportation and surface area play major roles. In this research, effort was taken to fabricate a cavity and a FTO layer inside the TiO_2 film in order to facilitate better charge collection and higher surface area.

Experimental

Three kinds of photoelectrodes were prepared by using the spray pyrolysis deposition method. One is (T) a reference with TiO_2 colloidal suspension. Second electrode (TC) is prepared with curcumin layer for leaving a cavity between two TiO_2 layers. Third one (TF) has a secondary FTO layer. All the samples were sintered and dipped in a N719 dye solution for 12 h and finally characterized by SEM and I-V measurements. All the sprayings were performed at 150°C using an improved spray deposition method except for the secondary FTO lyaer which was done at 500°C.

Results and Discussion

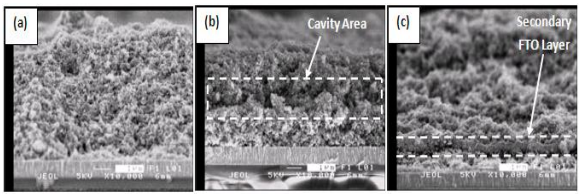
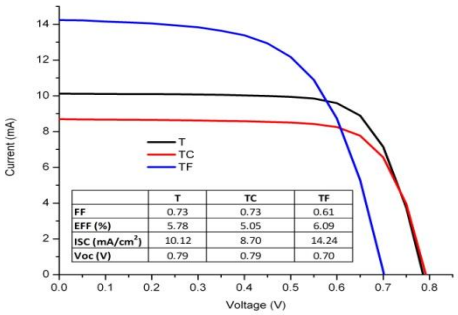


Fig. 1 : SEM images of (a)T (b)TC and (c)TF

Figure 1 reveals that TiO_2 films are well porous and about 8~10 μm in thickness. It is clear that curcumin layer has been burnt out leaving a cavity (Fig. 1(b)). The secondary FTO layer is visible in the TiO_2 layers with a thickness of about 500 nm (Fig. 1(c)).



	T	TC	TF
FF	0.73	0.73	0.61
EFF (%)	5.78	5.05	6.09
ISC (mA/cm^2)	10.12	8.70	14.24
Voc (V)	0.79	0.79	0.70

Fig. 2 : I-V Characteristics of the cells

It is found from the I-V characteristics and the photovoltaic performance that TF gives the highest J_{SC} and efficiency but the least V_{OC} and FF. The improved charge collection through secondary FTO layer may cause better $J_{SC,}$ while the compressed bottom TiO_2 layer may be an origin of the reduced V_{OC} and FF. TC is not effective as expected. The poor charge collection from the top TiO_2 layer may be the reason for the poor performance.

Conclusion

Fabricating the front electrode in layered structure improves the performance of a DSSC. In order to get better results, the layer thicknesses and charge collection has to be optimized.

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