Photovoltaic properties of dye sensitized solar cells using Cu-doped TiO_2

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Introduction

Dye sensitized solar cell (DSSC) is a promising alternative in the photovoltaic field to solve the future energy problem faces worldwide due to their environmental friendliness and low cost.[1,2] In the present work, DSSC based on Cu-doped TiO_2 semiconductor were performed. A study about the effect of Cu on structural and optical properties of TiO_2 nanoparticles and their influence on photovoltaic parameters was carried out.

Aim

The main objective of this work is to study the influence of Cu-doped TiO_2 semiconductor in DSSCs.

Materials & Methods

- Synthesis of 0.0%, 1.0% and 5.5% Cu-doped TiO_2 using low temperature method and annealed at 500 ^{0}C for 1h.[3]
- Preparing DSSCs based on Cu-doped TiO_2 NPs using doctor blade method.
- Structural and optical characterization by means of XRD and UV-Vis spectroscopy.
- I-V characterization to investigate the effect of Cu-doped TiO_2 on DSSCs.

Results & Discussion

XRD patterns of un-doped and Cu-doped TiO_2 are displayed in Figure 1. All patterns show the presence of anatase and rutile TiO_2 in the samples, being anatase the predominant phase. Furthermore, a decrease of band gap energy (Figure 2) in doped TiO_2 samples are observed due to presence of Cu. On the other hand, samples were used in photovoltaic applications. I-V curve (Figure 3) of the electrode prepared with Cu-doped TiO_2 shown an increase in V_{oc} (Figure 3). The efficiency was improved 10% with respect to DSSC prepared with pure TiO_2. A negative displacement of V_{FB} for cell C2 an C3 (Table 1) implies an increase in the V_{oc} (Figure 4)

Conclusion

For Cu-doped TiO_2 samples anatase was the predominant phase. The band gap energy of the Cu-doped semiconductors decreases and the V_{OC} of DSSCs increases because of the negative shift in V_{FB}.

References

1. Bisquert, J., Dilemmas of Dye-Sensitized Solar Cells. Chemphyschem, 2011. 12(9): p. 1633-1636.
2. Chu, S.M., A., Opportunities and challenges for a sustainable energy future. Nature 2012, 488, 294-303.
3. Navas, J. et al. Experimental and theoretical study of the electronic properties of Cu-doped anatase TiO2. Physical Chemistry Chemical Physics 2014, 16, 3835-3845.

Graphs

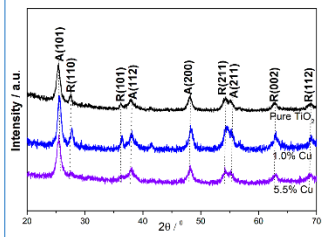

Fig. 1 XRD patterns.

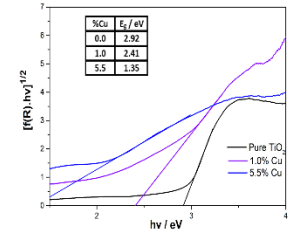

Fig.2 Tauc plots.

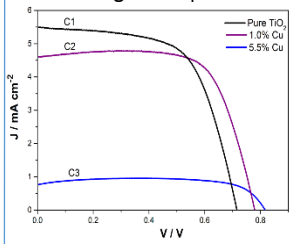

Fig. 3 I- V curves.

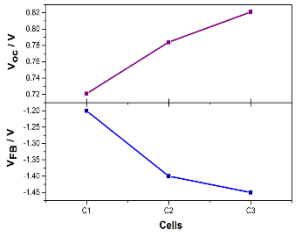

Fig. 4 Plot of the Voc and V_{FB} for the DSSCs.

Tables

Table 1. Composition of the photoelectrode of the DSSCs.

Cell	Semiconductor
C1	Pure TiO_2 (50%) + P25
C2	1.0wt% Cu/TiO_2 synthesized (50%) + P25
C3	5.5wt% Cu/TiO_2 synthesized (50%) + P25