

Enhanced Photocurrent of Au-TiO₂ Photoanode Excited by Grating-Coupled Surface Plasmon Resonance

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Introduction

We have previously reported that the short-circuit photocurrent in organic solar cells could be increased by using grating-coupled SP excitations in which a Blu-ray disc recordable (BD-R) is used as a grating substrate [1,2]. In this work, dye/Au-loaded TiO₂ films were fabricated on a metal grating surface to couple with surface plasmon resonance for further enhancement of photocurrent of Au-TiO₂ photoanode.

Experimental

The BD-R/Au/Au-loaded TiO₂ substrates were prepared by following our previous work [2]. 5, 10, 15, 20-Tetrakis (1-methyl-4-pyridinio) porphyrin tetra(p-toluenesulfonate) (TMPyP) and sodium copper chlorophyllin (SCC) were deposited as dyes on Au-loaded TiO₂ by layer-by-layer deposition technique. Ferrous sulfate heptahydrate (FeSO₄·7H₂O, 0.1 M), and sodium sulfate (Na₂SO₄, 1 M) were used as electrolytes. ITO glass substrate was used as the cathode.

Results Discussion and Conclusion

In this work, the dye-sensitized cell composed of the Au grating/Au-TiO₂/TMPyP-SCC LbL (20 bilayers)/electrolyte/ITO substrates were fabricated. The results showed that the grating-coupled surface plasmon

excitation together with Au-loaded TiO₂ could enhance the short-circuit photocurrent of the fabricated cells as shown in Fig. 1.

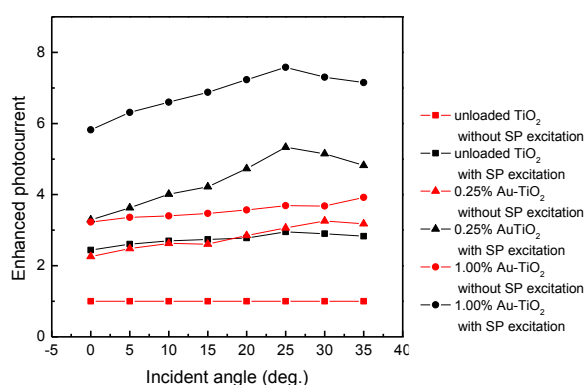


Fig. 1 Enhanced photocurrent factor as a function of the incident light angle. Here the enhancement factor is the ratio of the measured current in each sample to the current with unloaded TiO₂ and without propagating SP excitation.

References

- [1] A. Baba, K. Wakatsuki, K. Shinbo, K. Kato and F. Kaneko, "Increased short-circuit current in grating-coupled surface plasmon resonance field-enhanced dye-sensitized solar cells," *J. Mater. Chem.*, vol.21, pp.16436–16441, 2011.
- [2] A. Baba, N. Aoki, K. Shinbo, K. Kato and F. Kaneko, "Grating-Coupled Surface Plasmon Enhanced Short-Circuit Current in Organic Thin-Film Photovoltaic Cells," *ACS Appl. Mater. Interfaces*, Vol. 3, pp.2080-2084, 2011.