# Fabrication and Characterization of Pt-$MO_X$ Counter Electrodes for High Efficient Dye-Sensitized Solar Cell

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## Introduction

Dye-sensitized solar cell (DSSC) is a new type photoelectrochemical solar cell composed of dye-modified wide band semiconductor electrode and counter electrode and electrolyte containing redox couple ($I^-/I_3^-$). Due to low fabrication cost, its permanence, environmental compatibility, and simple process, interest in DSSC has grown considerably [1-2]. Although the cost of DSSC fabrication is 20% compared with silicon solar cell, for practical application the improvement of efficiency is inevitable. During the DSSC operation process, oxidized dyes are regenerated by the iodide in the electrolyte and finally triiodide converted to iodide at the counter electrode. To minimize the energy loss at maximum power point, the study of the electocatalytic characteristics of the counter electrode was conducted [3-4]. In this study, we prepared counter electrode consisting of Pt nanosized phase in amorphous porous oxide phase by cosputtering system and compared with other Pt electrodes.

## Experimental

Pt-$MO_X$ electrodes for counter electrode in DSSC were prepared by rf magneton cosputtering system on Fluorine-doped $SnO_2$-layered glass plates. The Pt-$MO_X$ film growth was conducted for 2min at rf powers of 30W and 40W on the Pt and oxide taget, respectively. XRD (X-Ray Diffraction) and TEM (Transmission Electron Microscopy) analyses were performed to study the structure of electrodes. And for comparison, other Pt electrodes were prepared by electron beam evaporation, thermal decomposition of $H_2PtCl_6$ and electodeposition. Several cells were fabricated by the conventional method and cell performance was measured using a xenon light source and AM 1.5 filter.

## Results and Discussion

Through the TEM images and XRD patterns of Pt-$MO_X$ electrodes, the formation of nanosized Pt crystalline of 8-10 nm mixed with porous oxide phase was confirmed. Figure 1 shows the I-V curves (power curves) of DSSCs fabricated with Pt and Pt-$MO_X$ electrodes by sputtering and cosputtering system, respectively. The active surface area of Pt-$MO_X$ electrodes was larger than that of Pt single phase electrode and the adhesion was improved. Consequently, the cell efficiency was increased from 3.2% to 4.3%. In addition, compared with the Pt electrodes produced by thermal decomposition of $H_2PtCl_6$ and electrodeposition, the fill factor and the efficiency of DSSC fabricated with sputtered counter electrode was improved due to the good adhesion and low charge-transfer resistance at the electrode/counter electrode interface.

## References

[1] B. O'Regan & M. Grätzel, *Nature*, **353:** 737-739 (1991).

[2] L. M. Peter, K. G. U. Wijayantha, *Electrochimica Acta*, **45:** 4543-4551 (2000).

[3] N. Papageorgiou, W. F. Maier, and M. Grätzel, *J. Electrochem. Soc*., **144:** 876-884 (1997).

[4] A. Hauch, A. Georg, *Electrochimica Acta*, **46:** 3457-3466 (2001).

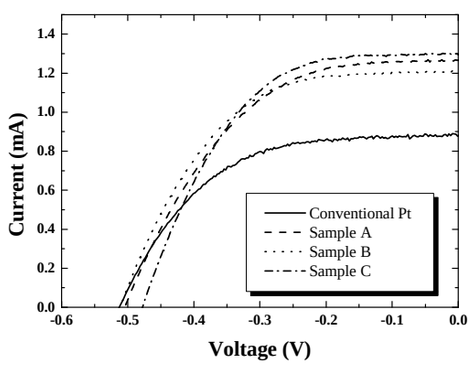


**Figure 1**. I-V curves of DSSCs fabricated with the Pt electrode and Pt-$MO_X$ electrodes.