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Abstract
This research studies the titanium dioxide （TiO2） thin film prepared by sputtering and applied to dye-sensitized solar cell. The main research items are: (1) prepared the TiO2 thin film by sputtering, (2) investigated the temperature parameter of the substrate or of annealing in thin film making process, (3) studied the photo-catalysis property, structure, roughness of the thin film,(4) explored the critical thickness and recession effect of the thin film.
The TiO2 thin films, used in this study, were fabricated by sputtering on TiO2 target, formed stacks of nano anatase crystal, and became transparent photo-catalytic films on the ITO glass substrate. The principal parameter in sputtering process is to change temperature of substrate holder in the sputtering chamber. Five different temperatures, 22, 50, 100, 150 and 200℃, were set on the substrate holder. After preparing TiO2 thin film, the transparency and absorptive performance of TiO2 thin film between 200~450nm were inspected by using UV-VIS Spectrophotometer. The hydrophilic property of TiO2 thin film by UV-light irradiation was observed by using contact angle measurement. The results showed that all the thin films, manufactured at different temperature, had ability to absorb UV-light and to perform good transparency. The contact angle measurement showed the films made by the higher temperature of substrate holder can get better hydrophilic property. In addition, the contact angle of thin film samples, made in 22℃on the substrate holder and then annealed between 100~350℃, were measured. Compared the results with those changing the substrate temperature, the contact angle showed the same for the films made either by changing the substrate temperature at 100℃ and 200℃or by 22℃on the substrate holder and then annealed in 100℃ and 200℃. That indicates the TiO2 thin film produced the same type of crystal type, analyzed by XRD in this research, at the same temperature state, in consequence, the photo-catalytic effect result in the change of contact angle on the thin film is the same. Apparently, the film made in pre-heat treatment and that made in post-heat treatment could obtain the same crystal type.
In the recession effect study by contact measurement, the thin film of 500nm thickness showed good hydrophilic property for about 2 weeks. In the critical thickness study, the thin films with thickness of 100, 300, 500 and 1000nm were irradiated under UV light for one, two, and three minutes, the results showed the hydrophilic property is proportional to the thickness of thin films, however the hydrophilic property would not increase at the thickness above 500nm. Therefore, in this study, the critical thickness of the TiO2 thin film is about 500nm.
Advisory Committee Ching-Hua Wei - advisor

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