Light Management In Mesoporous TiO2 Electrode for Dye-sensitized Solar Cells

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Nanocrystalline mesoporous materials have recently attracted much attention owing to their peculiar physical and chemical properties. Among wide-band gap metal oxides, nanocrystalline TiO2 is a most promising material for using as an electrode in dye-sensitized solar cell (DSC). Nanocrystalline TiO2 is normally synthesized by a sol-gel technique via hydrothermal process. Another promising method to obtain fine crystalline TiO2 is the surfactant-assisted templating method. Mesoporous TiO2 (MPTiO2) was synthesized by a modified sol-gel with laurylamine hydrochloride surfactant in a mild condition. The obtained TiO2 gel was coated on conducting glass by doctor blading. However, when the film thickness is increased, the thicker film tends to crack due to the film shrinkage. The large TiO2 particles are incorporated into the MPTiO2 gel to enhance the light scattering, to prevent the film cracking, and to reduce the interconnection among the particles. However, a decrease in surface area is increased by arising from the presence of large particles. The balance between light scattering and surface area is an important factor. In this work, the high crystallinity TiO2 and P25 powder were added in MPTiO2 gel. The various dyes, N719, porphyrin derivatives, and coumarin dyes, were used as sensitizer. The morphology of TiO2 electrode was modified by repetitive coating the blended of MPTiO2 gel with TiO2 powder. From the preliminary results, the double layered electrode, which consisted of transparent MPTiO2 and blended MPTiO2 with TiO2 particles, was fabricated to improve the cell performance by increasing the amount of adsorbed dye, improving light scattering, and decreasing the back-light scattering. The efficiency of double layered cell attained 9.15% with a \( J_{sc} \) of 17.1 mA/cm\(^2\), a \( V_{oc} \) of 0.751 V, and a fill factor of 0.711, as shown in Fig. 1. However, the suitable thickness of MP-TiO\(_2\) layer and the amount of TiO\(_2\) powder in MP-TiO\(_2\) gel should be optimized.

![Efficiency 9.15%, Jsc 17.12 mA/cm², Voc 751 mV and FF 0.711](image)

**Fig. 1 Photovoltaic characteristic of double layer cell**

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