

INFORMATION ON MASTER'S THESIS

1. Full name: NGUYEN VAN TUYEN
2. Sex: male
3. Date of birth: 03/13/1979
4. Place of birth: HAI DUONG
5. Admission decision number: 3568/QĐ-CTSV Dated: 12/31/2009
6. Changes in academic process:
7. Official thesis title:
Study synthesis ZnO, TiO₂ nanomaterials for dye sensitized solar cells
8. Major: Solid state physics
9. Code: 60 44 07
10. Supervisors: AProf. Dr Nguyen Thi Thuc Hien - Faculty of Physics - University of Natural Sciences - National University Hanoi.
11. Summary of the finding of the thesis:

Thesis: "Study synthesis TiO₂ nanomaterials for dye sensitized solar cells".
This thesis has achieved the following results:

1. Properties of TiO₂ buffer layer

- 1.1. SEM image

TiO₂ buffer layer fabricated by the sol-gel method with spinning covered technical, which adhere to the substrate ITO and high fineness (figure 1).

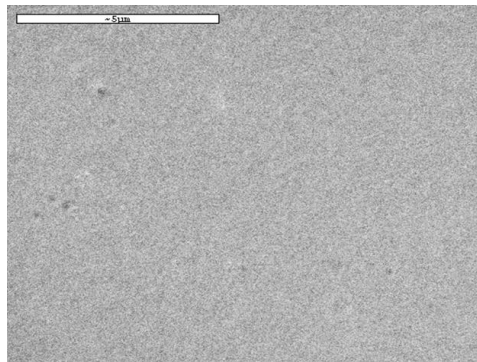


Figure 1 . SEM image of the TiO₂ buffer layer (sample SG04).

- 1.2. X-ray diffraction (XRD)

Buffer layer structured TiO₂ anatase phase (figure 2).

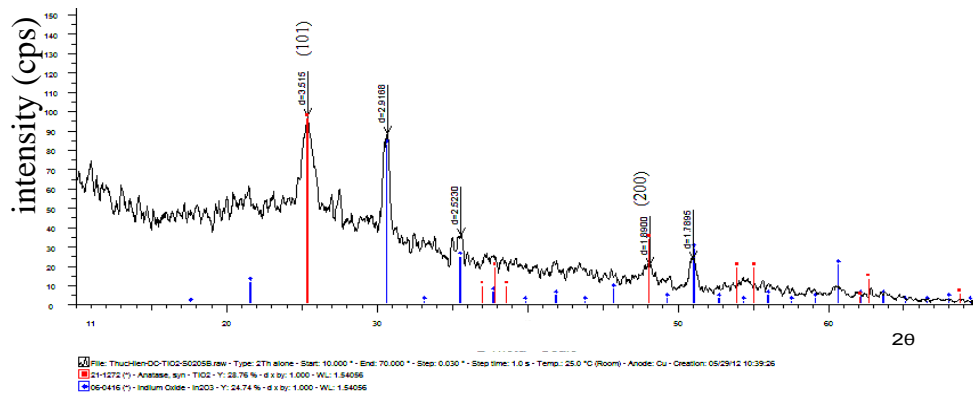


Figure 2. XRD of TiO_2 buffer layer is annealed at a temperature of 500°C , the sample SG05.

1.3. Transmission spectrum of the buffer layer

Buffer layer with high transmittance, over 85% in the visible light region, and less dependent on the annealing temperature (figure 3).

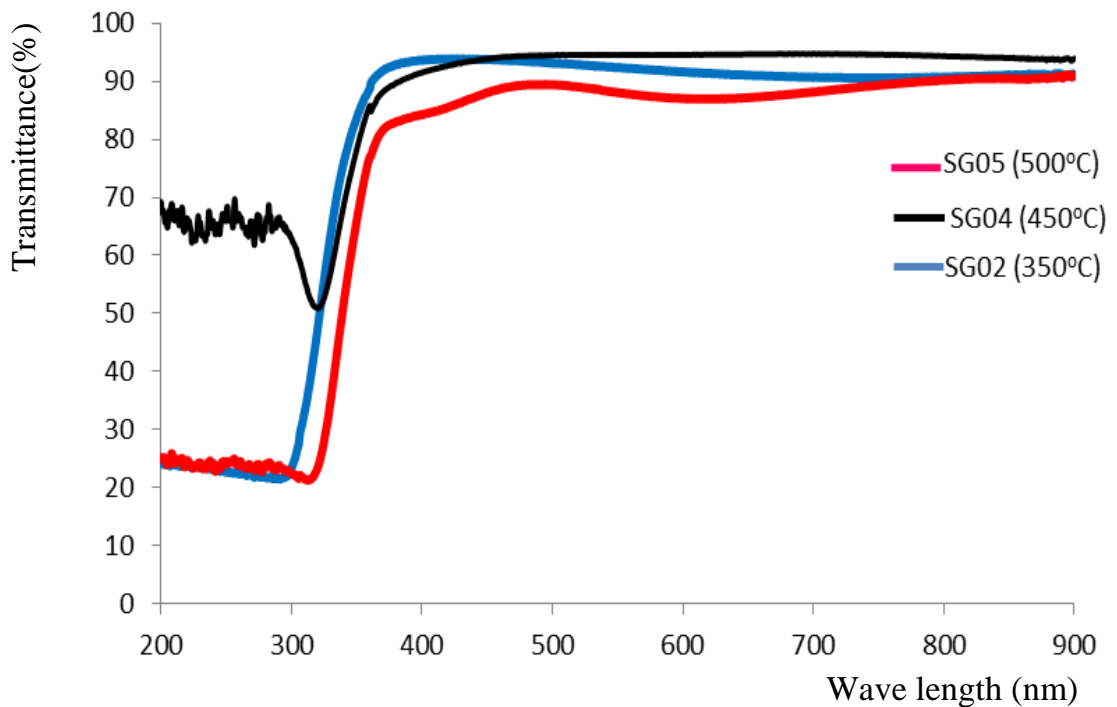


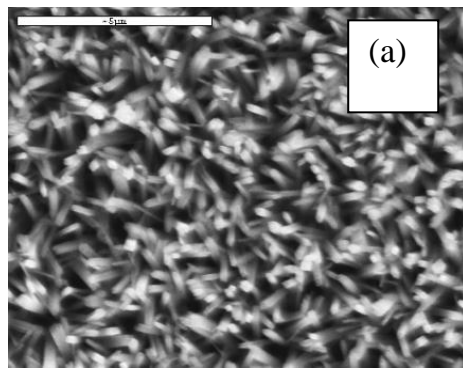
Figure 3. Transmission spectrum of the TiO_2 buffer layer was annealed at different temperatures, samples SG02, SG04, SG05.

2. TiO_2 nanorod films fabricated by hydrothermal method

2.1. SEM image

In the process of the experiment we found that the formation of TiO_2 nanorod films heavily dependent on the concentration of TBX and pH. TBX optimal concentration for the formation of TiO_2 nanorod films is 0.048 M. At lower

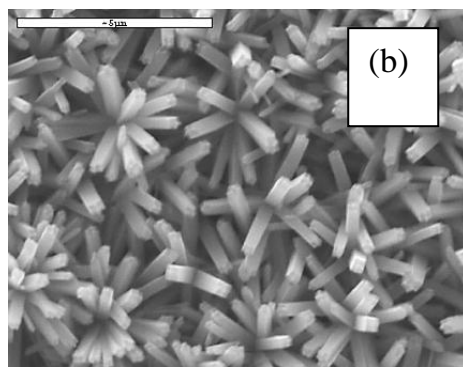
concentrations, we found, without the formation nanorod TiO_2 films on a base. When TBX concentration increased, the size of TiO_2 nanorod increases (figure 4).



a-sample TN12

ratio of TBX:HCl:H₂O is 1:30:30

Hydrothermal annealing time of 20 hours.



b-sample TN17

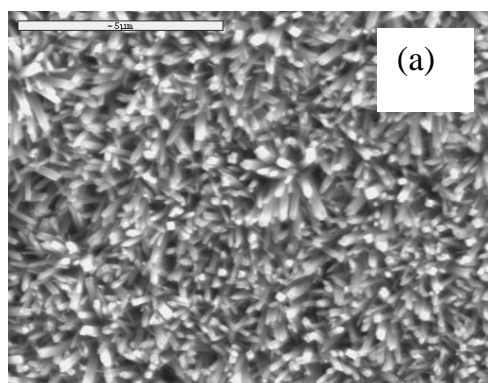
ratio of TBX:HCl:H₂O is 1.5:30:30

Hydrothermal annealing time of 20 hours.

Figure 4. SEM image of TiO_2 nanorod films with different TBX precursor concentration.

The best hydrothermal annealing temperature for the formation of TiO_2 nanorod thin films is 150 °C. At temperatures lower than 120 °C, did not see the formation of TiO_2 nanorod thin films on substrate. At a temperature of 180 °C or more non-film forming that substrate is corroded.

TiO_2 buffer layer plays an important role in the formation TiO_2 nanorod films (figure 5).

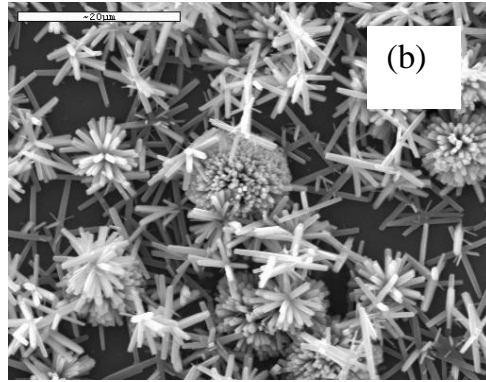


a-sample TN12

ratio of TBX:HCl:H₂O is 1:30:30

Using the ITO substrate with buffer layer TiO_2

hydrothermal time 20 hours.



b-sample TN17

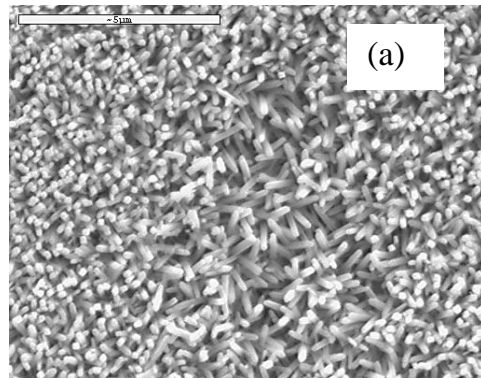
ratio TBX:HCl:H₂O is 1,5:30:30

Use glass substrate without buffer layer TiO₂

hydrothermal time 20 hours.

Figure 5. SEM image of nanorod TiO₂ films with (a) and without (b) TiO₂ buffer layer.

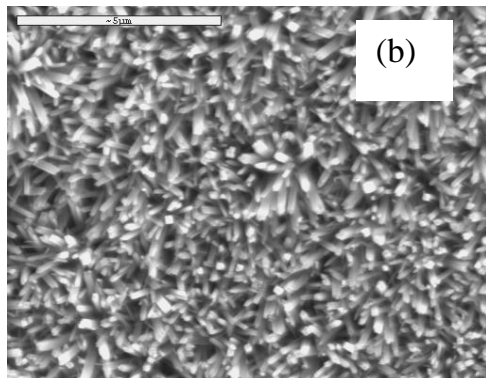
Size of TiO₂ nanorods depends greatly on hydrothermal annealing time (figure 6)



a-sample TN10

ratio TBX:HCl:H₂O is 1:30:30

hydrothermal time 4 hours.



b-sample TN12

ratio TBX:HCl:H₂O is 1:30:30

hydrothermal time 20 hours.

Figure 6. SEM image of TiO₂ nanorod thin films fabricated by hydrothermal method with different hydrothermal annealing time.

2.2. XRD

TiO₂ nanorod films structured rutile single phase, high crystalline (figure 7)

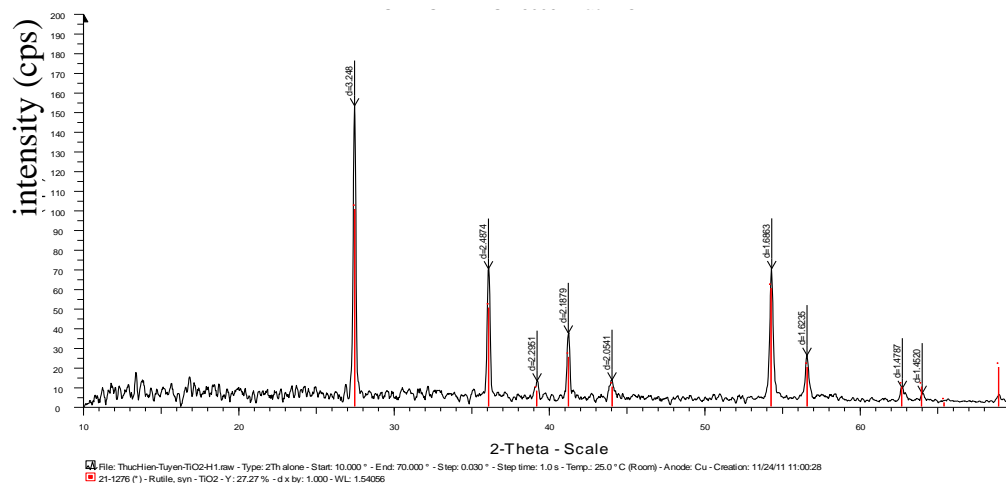


Figure 7. XRD of TiO_2 nanorod thin films, sample TN10.

12. Practical applicability:

The content of the thesis research has high-value applications, it is: fabrication of electrodes for DSSCs. DSSC is the solution to energy production cost cheaper than traditional solar cell Si and world interest.

13. Further research directions:

Should be studied performance of TiO_2 nanorod film in DSSC in the actual conditions.

Compare the performance of the DSSC using nanorod TiO_2 with film morphology different columns, different TiO_2 buffer layer.

14. Thesis-related publications: *None*

Date: 12/12/2012

Signature:

Full name: Nguyen Van Tuyen.