Synthesis and evaluation of Triethylamine-capped SnO_2 nanostructures for dye sensitized solar cell applications.

Murugesan Tarini, Mani Navaneethan, Jayaram Archana, Yasuhiro Hayakawa
Graduate school of Science and Technology, Research Institute of Electronics,
Shizuoka University, Hamamatsu 432-8011, Japan
Email:tarinims@gmail.com

[Introduction]

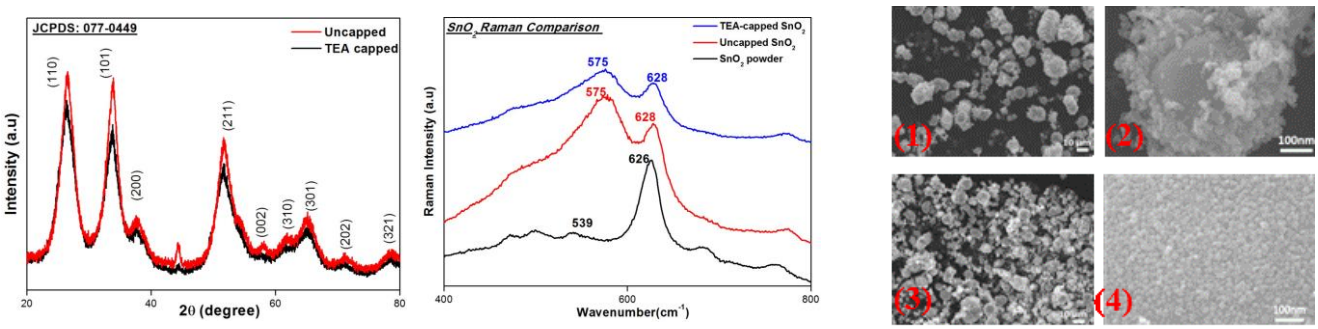
Solar energy is abundant and the need for alternative energy is increasing day by day. To overcome the climate change and increasing temperature of earth, use of renewable energy is required for the future generation. Dye sentitized solar cell (DSSC) are third generation solar cells found in 1991 by Gratzel et al using TiO_2 nanoparticles as a photoanode material [1]. Advantages of DSSC over silicon based solar cell is the low manufacturing cost, ecofriendly, easy tunable photoanode material, sensitizers and electrolyte [2]. SnO_2 has similar wide band gap with superior carrier mobility than TiO_2 and ZnO. SnO_2 has stable tetragonal rutile crystal structure [3]. We solvothermally synthesize TEA (triethylamine)-capped SnO_2 nanostrucutures and to prove that SnO_2 is a better alternative as photoanode material in DSSC application.

[Experiemental procedure]

For SnO_2 synthesis, 0.15 M of $SnCl_4.5H_2O$, 0.8 M of NaOH was added to 100 mL De- ionized water. 0.1 M TEA (used as capping agent) was added drop wise to the solution above and stirred vigorously for 12 h.The mixture was transferred to an 100 mL autoclave and solvothermal growth was carried out at 160°C for 12 h. Resulting solution was dried at 100°C for 12 h and annealed at 350°C for 2 h.The white powder obtained was used as photoanode material in DSSC using spray coating technique and efficiency of uncapped and capped samples were analyzed. Synthesized tin oxide materials were characterized by XRD, SEM, Raman, FTIR and XPS analysis. To find the efficiency of the SnO_2 based DSSC, I-V measurements were done.

[Result and Discussion]

Fig 1 (a) shows the XRD patterns of uncapped and TEA- capped SnO_2. The peaks were well matched with tetragonal phase of tin oxide (JCPDS No.77-0449). From Raman analysis as shown in fig 1 (b), the peak at 627 cm^{-1} attributed to A_{1g} symmetric Sn-O stretching mode. It confirmed the rutile structure. Raman band at 575 cm^{-1} was related to small size effect [4] and it was not present in bulk.Fig 1(c) shows SEM image of uncapped and TEA-capped microspheres (average of 2µm) surrounded with nanoparticles.These structures are suited for DSSC applications as the light reflects at different angle and recombination rate reduces.



(a) (b) (c)

Figure 1 (a) XRD of uncapped and TEA-capped SnO_2; (b) Raman spectrum comparison; (c) SEM images of uncapped (1, 2) and TEA-capped (3, 4) SnO_2.

References:

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