$H_2TI_2O_5 \cdot H_2O$ NANOWIRE AS AN INTERMEDIARY PHASE OF TIO_2 ANODE FOR DYE SENSITIZED SOLAR CELL

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Abstract

In the last years, nanostructures have been widely used in energy harvesting devices, such as dye-sensitized solar cells (DSSCs), nanogenerators, and fuel cells, due to their high efficiency and light weight [1-4]. Therefore, nanostructure based DSSCs are likely to be low-cost, high efficiency, and simple in preparation, which is promising as a renewable energy resource for sustainable development of the future. Besides DSSC applications, nanostructures have been used in energy storage fields, such as lithium ion batteries (LIBs), due to their highenergy density and long cycle life [5, 6]. A great challenge is to combine solar energy conversion and storage into one device. Using (Ti) sheet as substrate for TiO_2 nanorods grown as intermediary, the integrated power pack can be flexible and directly harvest and store energy by the electron conduction of the substrate. Thereby, using double-sided TiO_2 nanorods not only provide larger electrode area for DSSCs and LIBs but also can improve the electron transport properties of DSSCs and avoid irregular expansion when the insertion/removal of lithium along a specific orientation in anode material [7]. Compared with other integrated solar power supplies, double-sided TiO_2 nanorods with large area can be prepared by a simple, cost-effective, and controllable electrochemical process.

Moreover, such $H_2Ti_2O_5 \cdot H_2O$ material are good precursor of titania and metal titanate, and have well-controlled shapes such as nanotubes and nanosheets [8,9]. $H_2Ti_2O_5$ are usually synthesized by solvothermal treatment of titania or by ion-exchange of alkaline metal titanates. Until now, the synthesis of $H_2Ti_2O_5$ have been less frequently reported than those of other hydrogen titanates, such as $H_2Ti_3O_7$ and $H_2T_4O_9$, and it is formed as sheet-like particles[10,11]. The structure of $H_2Ti_2O_5$ has not been well established, it is reported to be a layered compound which is an isostructure to $K_2Ti_2O_5$ [12].

In this paper, we report the successful hydrothermal synthesis of $H_2Ti_2O_5 \cdot H_2O$ nanowire as an intermediary phase of TiO_2 anode for dye sensitized solar cell. The structure of products was determined by powder X-ray diffraction (XRD) PW 3040/60 X'Pert PRO using Cu-Kα radiation with (λ=1.5418Å), in the range 2θ = 10-80°, at room temperature. A Scanning Electron Microscope InspectS (SEM) was used to observe the morphology of synthesized nanocrystals. . The diffuse reflectance spectra (DSR) was obtained using a Lambda 950 UV-Vis-NIR Spectrophotometer with 150 mm integrating sphere in the wavelength range of 300–800 nm.

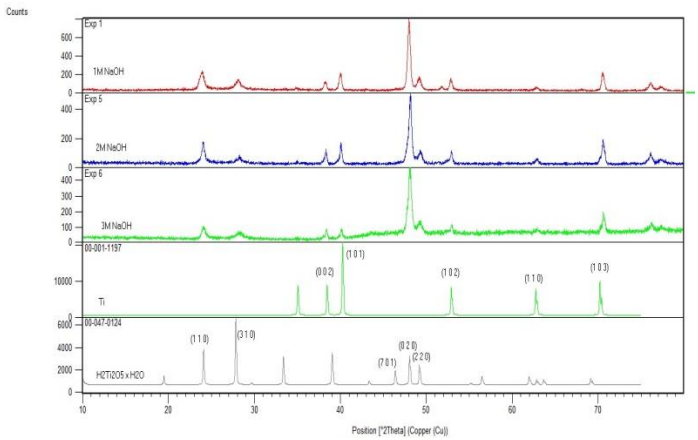

Figure 1. (a) X-ray diffraction patterns of $H_2Ti_2O_5 \cdot H_2O$ obtained at 220 °C for 24 hours at various concentrations of NaOH, a) 1M, b) 2M, c) 3M

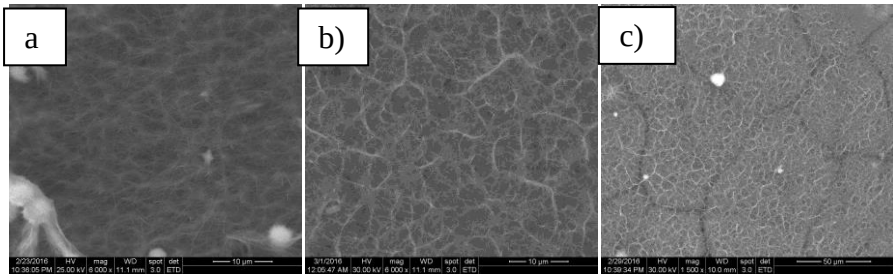

Figure 2.SEM images of $H_2Ti_2O_5 \cdot H_2O$ obtained at 220 °C for 24 hours at various concentrations of NaOH, a) 1M, b) 2M, c) 3M

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