

Fabrication of Patterned TiO₂ Nanorod Arrays by Laser Scanning Technology for Dye-sensitized Solar Cells

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Dye sensitized solar cells (DSSCs) have been regarded as one of potential alternatives to traditional photovoltaic devices for low cost, high efficiency and large scale production. However, for commercial application, the further efficiency improvement of DSSCs is required, which is limited by the electron transport and the electron recombination due to the poor interconnectivity and complicated boundaries among the nanoparticles network. So, it is necessary to tailor the film structure to improve the performance, and constructing the double layered photo-anode based on 1D and 0D nanostructures should be a better choice. In this paper, we constructed a bilayered TiO₂ photo-anode with patterned TiO₂ nanorod arrays as under layer and traditional TiO₂ nanoparticles as active layer. The patterned TiO₂ nanorod arrays, as shown in figure 1(d), were engineered by direct laser scanning technology. The patterned TiO₂ nanorod structure on the bottom layer can increase the light transmission and provide efficient electron transportation channel to the conducting substrate, and the efficiently filled TiO₂ nanoparticles can offer a sufficient internal surface area for dye absorption and excite more electrons. Scheme 1 illustrates the complete device structure, and we can see that the patterned TiO₂ nanorod arrays both act as a blocking layer to suppress the charge recombination and an anchoring layer to reduce the interfacial contact resistance. The final studies also showed that the patterned bilayered TiO₂ photoanode can suppress the recombination of electron/hole pairs and increase the light absorption. Hence, TiO₂ photoanode with novel micro/nanostructures and well-defined shape may open new opportunities and pave the way to further improve the energy conversion efficiency of DSSCs.

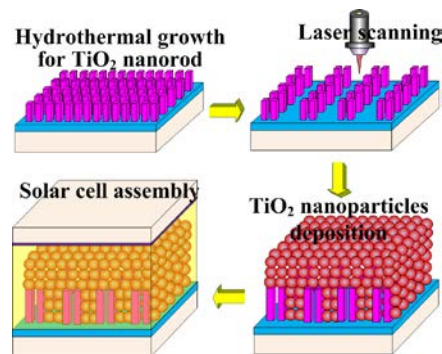


Figure 1: The schematic of patterned TiO₂ nanorod arrays based DSSCs

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