Enhancing Conversion Efficiency of Dye-Sensitized Solar Cells by Synthesis of Highly Ordered Titania Structures and Judicious Selection of Redox Couples

The objective is to use TiO_2 nanowire array as the dye host, whose ordered structure allows easy access of surface modification agents to effectively block the recombination reaction of dye injected electrons and the oxidized form of redox couple in the electrolyte (Figure 1A). Eventually, this will allow the judicious selection of redox couple to maximize the open circuit voltage and the overall conversion efficiency of the solar cell.

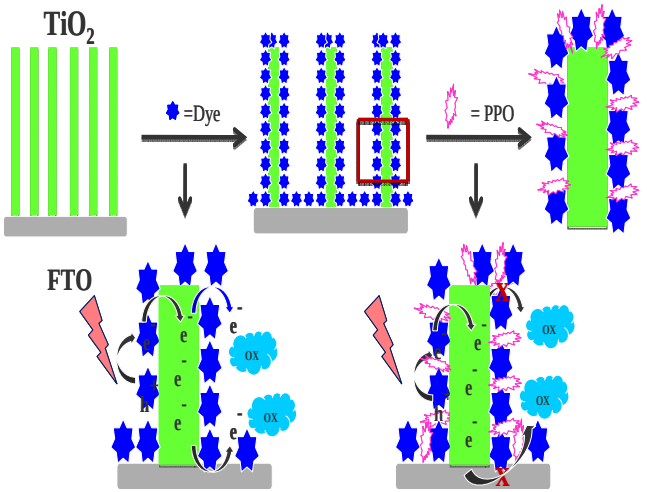

Fig. 1 (A)

Varying the precursor concentration, temperature and anisotropic adsorption agents, TiO_2 nanowire array has been grown on conductive glass substrates (Figure 1B).

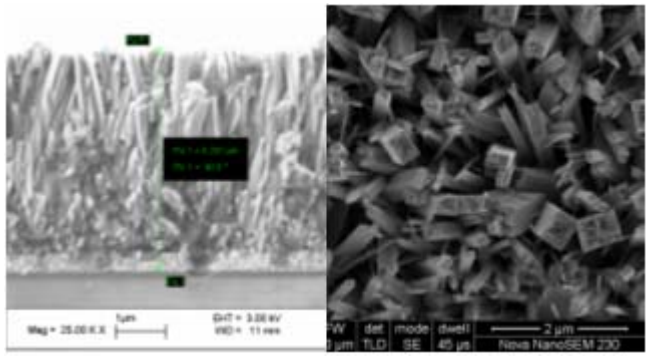

Fig. 1 (B)

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Two approaches have been developed for the surface inhibition. The first is to electrochemically deposit a layer of poly(phenylene oxide) and the second is to grow a monolayer of alkylsilane.

Figure 2A shows the I-V curves of solar cell using the nanowire array electrode that has been blocked through electrochemical polymerization of poly(phenylene oxide) with different polymer thickness. The effectiveness of the procedure has been demonstrated by the enhanced open circuit voltage of the solar cell after the treatment.

Shown in Figure 2B are the I-V curves of the solar cell before treatment (black curve) and after varying numbers of silanization treatments (colored curves). Clearly the short circuit current and the open circuit voltage are both increased, indicating the effectiveness of the silanization treatments.

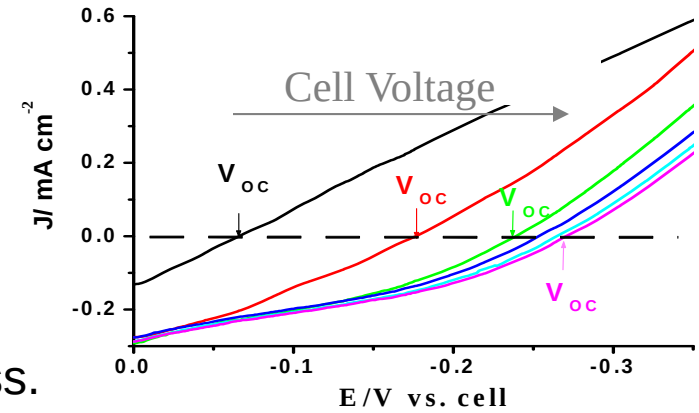

Fig. 2 (A)

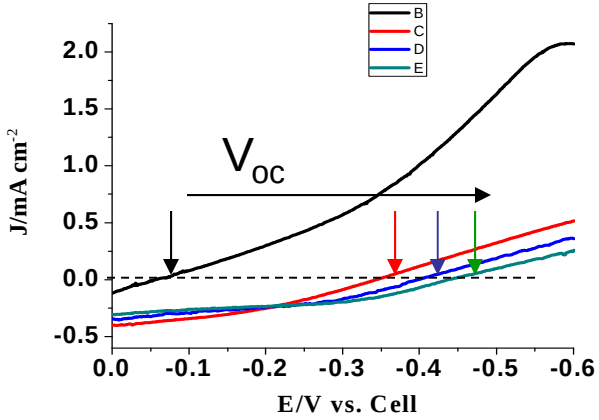

Fig. 2 (B)