Electrochemical reduction Graphene Oxide decorated reduced-TiO$_2$ nanotubes for photoelectrochemical water splitting

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Harvesting solar energy to produce clean hydrogen remains one of the main challenges for solving the energy crisis and ameliorating global warming. Photoelectrochemical (PEC) hydrogen production, using solar energy to split water, is a promising method for providing clean energy carriers in the future. Titanium dioxide (TiO$_2$) $[1]$, as one of the most important wide gap semiconductors, has been widely used in water photocatalysis and photoelectrochemical cells. However, its performance is still unsatisfactory due to its poor electrical conductivity, intrinsic fast electron-hole recombination, and narrower absorption range in the solar spectrum.

In this work, the novel TiO$_2$ nanotube arrays were prepared by electrochemical anodization and rapid annealing treatment. Besides, we present electrochemical reduction TiO$_2$ nanotube arrays (H-TiO$_2$NTs) to enhance its UV absorption. In order to improve the stability of H-TiO$_2$NTs, a certain amount of Graphene Oxide (GO) was dissolved in the electrolyte during the electrochemical reduction process $[2]$. The obtained products were used as photoelectrode for H$_2$ production under light irradiation by using 1M KOH as the electrolyte. In addition, we also investigated the function of rGO modified TiO$_2$ nanotubes for water splitting. It indicated the rGO sheets not only acted as an electron acceptor to prevent from the photogenerated carriers recombination but also largely improved the conductivity compared with pristine TiO$_2$ nanotubes $[3]$. As a result, the rGO-TiO$_2$ nanotubes photoelectrode showed the maximum photocurrent density of 4.8 mA/cm$^2$ (at 0V vs. Ag/AgCl) under light irradiation, which is about 2.2 times larger than pristine TiO$_2$ nanotubes. The results were showed in Figure 1.

![Figure 1](attachment:Figure1.png)

**Figure 1.** (a) SEM images of pristine TiO$_2$NTs; (b) rGO-TiO$_2$NTs; (c) LSVs of all prepared materials under illumination by using 1M KOH as the electrolyte.

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**Reference:**