S-TiO_2/S-Reduced Graphene Oxide for Enhanced Photoelectrochemical Water Splitting

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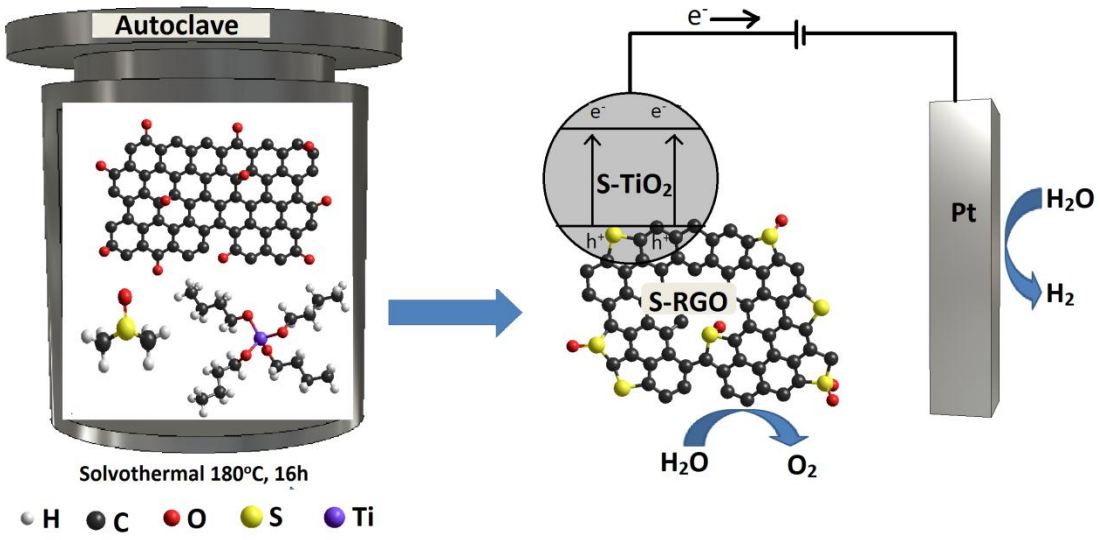
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Abstract

Sulfur-doped titanium oxide on the surface of sulfur-doped reduced graphene oxide nanocomposites (S-TiO_2/S-RGO) were successfully synthesized for the first time through a simple low cost solvothermal reaction process. The sulfur doping was detected in both TiO_2 matrix and carbon framework structure of reduced graphene oxide using X-ray photoelectron spectroscopy (XPS) and Energy-dispersive X-ray spectroscopy (EDX). Cross-sectional AFM analysis of S-RGO nanosheets reveals a thickness of 0.51 nm which is much thinner than those previously reported of heteroatom doped-RGO, confirming the single-layer feature. When the as-prepared (S-TiO_2/S-RGO) nanocomposites are utilized as photoanodes for photoelectrochemical (PEC) water splitting, they exhibited an enhanced photoelectrochemical performance and long-term stability. The photocurrent density of S-TiO_2/S-$RGO_{(0.2)}$ photoanode revealed 3.36 mA/cm^2 at 1 V vs Ag/AgCl which is considered 3 times enhancement compared to bare synthesized TiO_2. This enhancement in the photocurrent density was attributed to the increased separation rate of photogenerated electrons and holes and efficient visible light harvesting as a result of the successful combination of the S-TiO_2 and the S-RGO in the same nanocomposite photoanode. This promising result presents a new approach for the synthesis of high-efficient future metal-free photoelectrocatalysts.

Keywords**:** S-TiO_2; S-RGO; photoanode; Photoelectrochemical water splitting.

Graphical abstract



Schematic illustration of the preparation of S-TiO_2/S-RGO nanocomposites and the mechanism of the PEC water splitting.