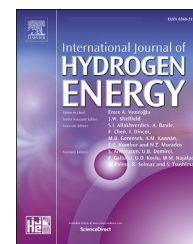


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# Titanium dioxide-coated copper electrodes for hydrogen production by water splitting

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## HIGHLIGHTS

- Development of TiO<sub>2</sub>-C/Cu electrode for hydrogen production by UV irradiation.
- Cu corrosion was prohibited due to TiO<sub>2</sub> layer.
- Enhancement of hydrogen production by TiO<sub>2</sub>-C/Cu electrode.
- Decomposition of formaldehyde in artificial wastewater by TiO<sub>2</sub>-C/Cu electrode.

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## ABSTRACT

Pt is the most commonly used electrode and catalyst materials for H<sub>2</sub> production via water splitting as it provides the highest Gibbs free energy of H<sub>2</sub> adsorption ( $\Delta G_H$ ) and overpotential. However, as Pt catalysts are expensive and difficult to mass-produce, several efforts have been made to identify suitable substitutes. Although Cu provides lower  $\Delta G_H$  and overpotential than Pt, it exhibits better catalytic performance than other catalysts and is suitable for H<sub>2</sub> production. However, corrosion of Cu may affect its stability of Cu electrode. To overcome this limitation, we have coated a layer of carbon on the copper electrode and then synthesized titanium dioxide (TiO<sub>2</sub>) on the C/Cu electrode for water splitting application. Carbon black (CB) has excellent electrical conductivity and stable resistance for effective working as an electrochemical catalyst, and TiO<sub>2</sub> has diverse applications because of its low-cost, non-toxic, and corrosion-resistant characteristics. In this study, TiO<sub>2</sub> was synthesized on C/Cu electrodes under UV irradiation for different durations. The optimum irradiation duration was determined to be 15 min via surface and electrochemical analyses. To identify the potential applications of this TiO<sub>2</sub>-C/Cu electrode, we used artificial wastewater as the electrolyte. The synthesized TiO<sub>2</sub>-C/Cu electrode exhibited better stability than C/Cu electrode. Further, H<sub>2</sub> production with TiO<sub>2</sub>-C/Cu electrode was higher than that with C/Cu electrode at the same current density. We also investigated the effect of TiO<sub>2</sub>-C/Cu electrode on decomposition of formaldehyde.

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