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

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## HIGHLIGHTS

- Development of  $\text{TiO}_2$ -C/Cu electrode for hydrogen production by UV irradiation.
- Cu corrosion was prohibited due to  $\text{TiO}_2$  layer.
- Enhancement of hydrogen production by  $\text{TiO}_2$ -C/Cu electrode.
- Decomposition of formaldehyde in artificial wastewater by  $\text{TiO}_2$ -C/Cu electrode.

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## ABSTRACT

Pt is the most commonly used electrode and catalyst materials for  $\text{H}_2$  production via water splitting as it provides the highest Gibbs free energy of  $\text{H}_2$  adsorption ( $\Delta G_{\text{H}}$ ) 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  $\Delta G_{\text{H}}$  and overpotential than Pt, it exhibits better catalytic performance than other catalysts and is suitable for  $\text{H}_2$  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 ( $\text{TiO}_2$ ) 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  $\text{TiO}_2$  has diverse applications because of its low-cost, non-toxic, and corrosion-resistant characteristics. In this study,  $\text{TiO}_2$  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  $\text{TiO}_2$ -C/Cu electrode, we used artificial wastewater as the electrolyte. The synthesized  $\text{TiO}_2$ -C/Cu electrode exhibited better stability than C/Cu electrode. Further,  $\text{H}_2$  production with  $\text{TiO}_2$ -C/Cu electrode was higher than that with C/Cu electrode at the same current density. We also investigated the effect of  $\text{TiO}_2$ -C/Cu electrode on decomposition of formaldehyde.

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