Highly effective B@g-C_3N_4/polyaniline nanoblend for photoelectrocatalytic reduction of CO_2 to methanol

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ABSTRACT

Photoelectrocatalytic (PEC) conversion of CO_2 has been extensively investigated as it uses solar energy to combine CO_2 and water to produce hydrocarbons. In the present work, B@graphitic carbon nitride (g-C_3N_4)/polyaniline (PANI) nanoblend was synthesized by in situ polymerization of aniline in the presence of B@g-C_3N_4 for PEC CO_2 reduction. The catalyst was characterized by field emission scanning electron microscopy (FESEM), transmission electron microscopy, X-ray diffraction, UV-Vis absorption spectroscopy, photoluminescence, X-ray photoelectron spectroscopy (XPS), and Mott-Schottky analysis. The PEC activity was evaluated by linear sweep voltammetry (LSV) and chronoamperometry. XRD revealed the formation of g-C_3N_4, while B doping was confirmed by XPS. The presence of PANI was visualized by FESEM. A remarkable cathodic current associated with CO_2 reduction was observed during LSV from an onset potential of –0.01 V vs. normal hydrogen electrode (NHE), which is more positive than that of B@g-C_3N_4 (–0.82 V vs. NHE), and the positive shift is attributed to the slow charge recombination kinetics of B@g-C_3N_4/PANI as evidenced by PL results. The mechanism of PEC CO_2 reduction was investigated and discussed on the basis of the Mott-Schottky results. In conclusion, B@g-C_3N_4/PANI opens a new avenue to develop photoelectrocatalysts for PEC CO_2 reduction to methanol.

KEYWORDS

Carbon dioxide reduction; Graphitic carbon nitride; Nanoblend; Photocatalyst; Photoelectrocatalysis

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