Photocatalytic generation of syngas using combustion-synthesized silver bismuth tungstate

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Abstract

Silver bismuth tungstate (AgBiW2O8) nanoparticles were prepared for the first time by solution combustion synthesis by using the corresponding metal nitrates as the precursor and urea as the fuel. These nanoparticles were subsequently modified with Pt catalyst islands using a photocatalytic procedure and used for the photogeneration of syngas (CO+H2). Formic acid was used for this purpose for the in situ generation of CO2 and its subsequent reduction to CO. In the absence of Pt modification, H2 was not obtained in the gas products evolved. These results were compared with those obtained with acetic acid in place of formic acid. The combustion process was simulated by thermogravimetry and the synthesized powder was characterized using transmission electron microscopy, diffuse reflectance UV/Vis spectroscopy, X-ray diffraction, surface area measurements, and X-ray photoelectron spectroscopy. Tauc plots derived from the diffuse reflectance data yielded an optical band gap of 2.74 eV. The photocatalytic activity of these nanoparticles was superior to a sample prepared by solid-state synthesis. Mechanistic aspects are finally presented, as are structural models and electronic calculations, using density functional theory (DFT).

Keywords: combustion synthesis; CO2 remediation; heterogeneous catalysis; silver; titanium dioxide