SYNTHESIS AND CHARACTERIZATION OF TITANIUM DIOXIDE BASED TERNARY NANOCOMPOSITES FOR PHOTOCATALYTIC HYDROGEN PRODUCTION

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Abstract

Titanium dioxide based photocatalysts of different graphene oxide (GO) and silver nanoparticle (AgNP) content were prepared and tested in catalytic methanol reformation reaction. Aqueous suspensions of the composite solids obtained by heterocoagulation of alkaline exfoliated GO suspension and slightly acidic TiO_2 suspension showed enhanced sedimentation rate at pH = 6.5-7, when they contained less than 2 wt% graphene oxide. This enables easier catalyst recovery but the suspension needs to be stirred strongly during the catalytic run in order to achieve homogeneous light distribution within the reaction vessel.

The catalytic runs were performed in 6 V/V% methanol/water mixture using 500 mg/L catalyst under UV-illumination. The activity of pure titanium dioxide (Degussa P25) continuously increases and reaches a saturation plateau after 150 min with an activity of 0.12 mmol $H_2/(h \times g_{cat})$. Incorporation of GO into the titanium dioxide matrix by heterocoagulation method results in aggregated suspensions exhibiting an enhancement of the hydrogen evolution rate to the saturation value of 0.17 mmol $H_2/(h \times g_{cat})$. Deposition of different amounts of AgNPs of different sizes onto the surface of titanium dioxide resulted in an even higher photocatalytic activity, reaching 0.25-0.29 mmol $H_2/(h \times g_{cat})$. The combination of AgNP's and GO platelets to obtain ternary TiO_2 based catalysts has not shown any further increase of hydrogen generation rate.