BiOI/BiOCl Composite Photocatalysts – Synthesis, Characterization, and Application for the Elimination of Organic Pollutants Using Various LED Light Sources

Tünde Alapi[1], Máté Náfrádi[1], Tamás Hlogyik[1], Klára Hernádi[2]
[1]Department of Inorganic and Analytical Chemistry, University of Szeged,
H-6720 Szeged, Dóm sq 7, Hungary
[2]Department of Environmental and Applied Chemistry, University of Szeged,
H-6720, Szeged, Rerrich Béla sq 1., Hungary

Semiconductor photocatalysis driven by visible light has become the world hot topic of intensive interest due to its potential applications in environmental purification and solar energy conversion by utilizing visible light. In the recent past, bismuth oxyhalides (BiOX, X=Cl, Br, I) have been widely used for the photocatalytic degradation of the organic pollutants and other environmental remediation. Because of their advantageous properties, bismuth oxyhalides, serve as potential alternatives for TiO_2, the most often used photocatalyst. The unique characteristic layered structure of BiOXs tends to inhibit the recombination of photogenerated electron-hole pairs and allow them to tune their light response from visible to UV light range. Benefitting from the unique properties, BiOXs have shown promising photocatalytic application for the degradation of organic pollutants.

In this work, BiOCl, BiOI and BiOI/BiOCl composite photocatalysts were prepared using solvothermal crystallization method. The efficiency of photocatalysts were determined under radiation with various light sources: mercury vapour lamps (300-400 nm) and LED light sources (LED – UV (398 nm), LED - cold white light and LED - warm white light) were applied, and methyl orange dye was used as target substance. Since adsorption has a crucial role in the case of heterogeneous photocatalysis, adsorption capacity of photocatalysts were determined in aqueous solution of methyl orange.

BiOI adsorbed two times higher amount of dye than BiOCl. BiOI/BiOCl composite photocatalysts showed enhanced activity in decolorization and transformation of methyl orange comparing to the BiOI and BiOCl. The composite having highest activity contained 80% BiOI and 20% BiOCl: in this case the transformation rate of methyl orange was two times higher than in the case of BiOCl and one magnitude higher than in the case of BiOI. There was found significant difference between the transformation rates and quantum efficiency determined under the radiation of various LED light sources. There was no •OH radical formation, the transformation of methyl orange takes place via direct charge transfer and the first step was proved to be demethylation.

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