

Abstract

Dissertation thesis entitled "Assessment of the impact of graphene oxide and silver nanostructures on photocatalytic activity of titanium dioxide" is based on the study of titanium dioxide coatings modified with graphene oxide (GO) flakes and/or silver nanostructures (AgNS). Coatings were obtained by the sol-gel method combined with dip-coating technique. Graphene oxide was also deposited by dip-coating technique. Silver nanostructures were obtained by photocatalytic reduction. The study of photocatalytic properties was based on photocatalytic transformations of rhodamine B determined by UV-Vis spectrophotometric method. Changes of absorption spectrum caused by UV and Vis range were monitored separately.

The theoretical part of the work describes the methods that are used to improve the photocatalytic activity of titanium dioxide. Separate chapters were assigned to silver nanostructures (AgNS) and graphene materials (G, i.e. graphene, graphene oxide and reduced graphene oxide). Moreover the synthesis of two-component ($\text{TiO}_2\text{-AgNS}$ and $\text{TiO}_2\text{-G}$) and ternary ($\text{TiO}_2\text{-G-AgNS}$) photocatalysts, their photocatalytic properties based on the degradation of contaminants and proposed electron flow mechanisms were analyzed. Furthermore The results of individual works questioning the effectiveness of the use of graphene materials in photocatalysis due to the lack of resistance of these materials to the action of reactive oxygen species were also discussed.

The experimental part is divided into chapters including: 1) description and characteristics of titanium dioxide coatings and discussion of rhodamine B photocatalytic transformations in UV and Vis irradiation range, 2) modification of TiO_2 coatings with AgNS having various sizes and numbers, and the impact of these parameters on the photocatalytic activity of a two-component system, 3) modification of TiO_2 coatings with GO flakes with a certain degree of coverage and its dependence on the photocatalytic activity, 4) modification of TiO_2 coatings with both GO flakes and AgNS forming 3 types of "architectures" differing in the method of preparation, including determining the impact of GO flakes on AgNS growth and determining the causes of AgNS growth on GO subsequently, ending with a comparison of photocatalytic properties of the obtained ternary systems, 5) analysis the stability of GO flakes deposited on TiO_2 during irradiation. The summary refers to the mechanisms proposed in the literature and objectively evaluated the impact of TiO_2 coating modifications on the photocatalytic activity of prepared systems in UV and Vis irradiation range.

Coating morphology was examined using SEM. The crystallographic structure was determined using XRD. The value of the band gap of photocatalysts was determined by the DRS technique. The reasons of AgNS growth on GO were investigated by SEM, EDS and FT-IR techniques. The stability of GO flakes was determined by SEM techniques and Raman spectroscopy.