Abstract

The presented doctoral thesis entitled "*The use of mechanochemical, hydrothermal and microwave processes for the preparation and modification of composite materials and selected metal oxides capable of photocatalytic degradation of organic dyes*" is a series of six research papers published in the peer-reviewed scientific journals from the list of the Ministry of Education and Science [**D1-D6**].

The elimination of organic pollutants contained in water plays an important role in the technology of pollution reduction and protection of the natural environment. Much attention has been devoted to the advanced oxidation processes, the essence of which is the production of reactive compounds, especially hydroxyl radicals, which are strong oxidants and take part in photocatalytic reactions. The use of appropriate semiconductor materials in the photocatalytic processes enables complete mineralization of organic compounds to CO_2 and H_2O.

The scientific objective of the doctoral thesis was the preparation of composite materials with photocatalytic properties, mainly in the visible light range (vis), using the mechanochemical synthesis method. The synthesis of titanium(IV) oxide and zirconium(IV) oxide using the precipitation and mixed oxide of cerium(IV) and zirconium(IV) the co-precipitation was conducted. The influence of post-synthetic modification (mechanochemical, hydrothermal and microwave) on the physicochemical and photocatalytic properties of the obtained materials was analyzed. The following dyes: methylene blue, safranin T and rhodamine B were used as the model organic pollutants. The mechanocatalytic properties of the selected materials with respect to rhodamine B were also tested using the planetary ball mill.

On the basis of the tests, it was shown that the obtained materials were mostly characterized by photocatalytic properties in the vis range. Both the method of synthesis and the use of the additional post-synthetic modification had a decisive effect on the photoactivity. A large role in the creation of photocatalytic (vis) and physicochemical properties was played by the parameters of the applied modification, including temperature, the form of the starting material (gel or xerogel) and the synthesis conditions (water or air).

Keywords: photocatalysts, mechanochemical synthesis, mechanochemical treatment, hydrothermal treatment, microwave treatment

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