DESCRIPTION FOR THE GENERAL PUBLIC

The power delivered to the Earth from the Sun is an available source of energy that can be used to obtain electricity as well as to degrade contaminants, organic compounds being a great health hazard to human life. It is also important from the point of view of the increasing water and air pollution as a result of the development of civilization and constantly rising human population. There is a scientific discipline which handles with the exploitation of irradiation in such ways as production of electricity or hydrogen, decomposition of water and air contaminants and pollutants covering solids (dirt on the window glass, building facades, etc.). It is called photocatalysis. As long as the fuel for photocatalysis is irradiation, the engine that drives the conversion of irradiation is photocatalyst. It is a substance which effectively accelerates the process of photocatalysis and at the same time is not consumed. One of the most investigated photocatalyst is titanium dioxide (TiO_2) as it is nontoxic, biologically and chemically inert, photostable, inexpensive and exhibits a high photocatalytic activity under the near ultraviolet light (UVA). There is a disadvantage of TiO_2 it is its low photoconversion below 5% as a result of sunlight absorption in the UVA range. The objective of this project is to extend the range of TiO_2 activity to visible light and to increase its photocatalytic performance. In order to obtain this result the preparation of photocatalyst consisting of TiO_2, graphene and silver nanoparticles was proposed. The combination of the unique properties of TiO_2 with the possibility of silver nanoparticles excitation in the visible range of light and an excellent electrons conduction through graphene will help improve the efficiency of the photocatalysis.

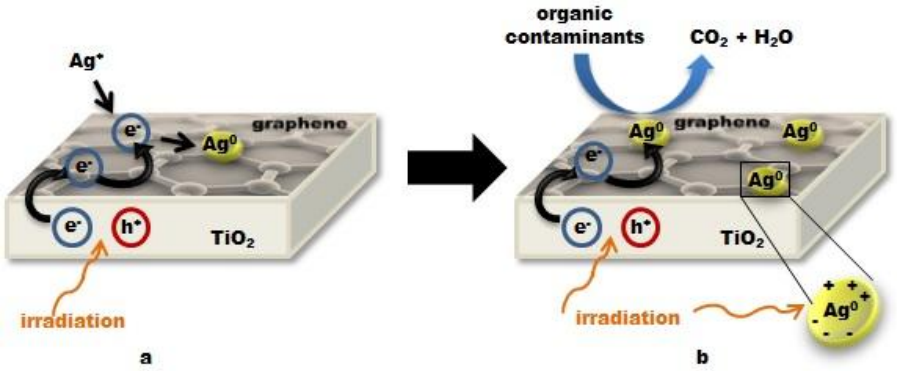

Fig. 1: Scheme of (a) the photocatalytic growth of silver nanoparticles from silver ions solution on the photocatalyst containing TiO_2 and graphene, (b) decomposition of organic contaminants on the photocatalyst containing TiO_2 and graphene and silver nanoparticles.

The principle of the photocatalyst will consist in the electron transfer between three components: TiO_2, graphene and silver nanoparticles. UV illumination of the TiO_2 surface induces the separation of two carriers: an electron (e^-) and a hole (h^+), which can initiate reduction and oxidation of organic compounds (pollutants) decomposing (turning) them into water and carbon dioxide. Silver nanoparticles have unique attributes: their ability to transfer electron from TiO2 as well as enhance the photocatalytic performance of TiO_2 due to extend the absorption activity to the visible light. Furthermore, the task of the 2D carbon network of graphene is the acceleration of the electron transport between TiO_2 and silver nanoparticles.

In order to achieve the goal of the project a series of basic research will be carried out. The research will give the answer to the question about how graphene will influence the growth of silver nanoparticles by the photoreduction of silver ions to metallic silver (Fig. 1. a). Afterwards the relationship of the photocatalytic properties to the structure of photocatalysts will be determine by monitoring the decomposition rates of selected organic compounds under UV and Vis illumination. Consequently, based on the results of basic research, the method of the photocatalyst preparation operating under UV and visible irradiation will be developed as well as the mechanisms of the electron transfer between TiO_2, graphene and silver nanoparticles will be explained.