Description for the general public

The presence of various contaminants in water and air, in particular organic pollutants, has a big impact on increasing the problem of deteriorating human health. New and more effective solutions for pollution removal are intensively being looked for. It is important that, new methods should be environmentally friendly and fulfills the assumption of "green chemistry". The methods should eliminate problem with transfering of pollutants from one phase to the other and as well as the formation of dangerous and difficult for the utilizing by-products and intermediate products. According to this, the alternative and supplementation to the classical methods became the Advanced Oxidation Processes (AOPs), including, the photocatalysis processes. Using photocatalysis, the pollution both from the air and water can be removed. Thanks to photocatalysis it is possible to decompose pollutants into simple inorganic compounds such as H_2O and CO_2. Photocatalysis can be used to decomposition of such compounds as carboxylic acids, chlorinated aliphatic compounds, water-miscible solvents, pesticides, surfactants or dyes. The most popular used photocatalyst is titanium dioxide, which in pure form is a non-toxic, colorless solid with high chemical and physical stability. Pure titnium ioxide exists in three forms: anatase, rutile, and brookite. Both anatase and rutile show photochemical properties and both forms well absorb UV irradiation. However, in the photocatalytic processes mainly anatase. Photocatalytic activity depend on the type of TiO_2 precursor and its physicochemical properties such as: specific surface area, crystalline phase, crystallite size and porous structure. Unfortunately, titanium dioxide shows large level of electron-hole pairs recombination that influences the reduction of the photocatalytic activity and the same it limits its usage. A big problem is also the fact that titanium dioxide can be activated only by UV irradiation due to wide band gap. According to this, one of the most important aims for the scientists that deal with the photocatalysis process is modification of a photocatalyst on the basis of titanium dioxide to improve its properties and photoactivity. Until now, many photocatalytic system based on the photocatalytic titanium dioxide which show increased activity were obtained. However, the need to discover new materials and the development of innovative strategies for increasing the reactivity of photocatalysts play an indispensable role in the development of technology. Such a way of modification can be suitable combination of TiO_2 with silicon.

The aim of proposed project is preparation and characterization on innovative photocatalysts based on titanium dioxide (TiO_2) modified with silicon from 3-aminopropyltriethoxysilane (APTES). An important element of the project will be a detailed description of the obtained nanomaterials, and, above all, the determination of the impact of modification parameters on physical and chemical as well as adsorption and photocatalytic properties. Particular emphasis is placed on the determination of impact used silicon and other elements contained in precursor (APTES-$C_9H_{23}NO_3Si$), especially nitrogen, on TiO_2 structure. Propose method modification will cause delay the phase transformation from anatase to rutile and prevent the growth of crystallites in higher temperature. These changes will increase photocatalytic activity, especially in visible light, and will enhance adsorption properties of obtained materials. Photocatalytic activity measurements will be provide by decomposition of different model water and air contaminations under different types of irradiation : artificial solar and visible light. . It is planned to carry out a lot of tests using advanced analytical methods, such as: electron paramagnetic resonance spectroscopy, measurement of the recombination rate of electron-hole carriers or determination of the structural model of new nanocomposites using the DFT method. The results of the research will be published in international journals with high impact factor. The presentation of the results will also include speeches at international and national conferences.