Description for general public:
state the objective of the project, described research, reasons fot choosing the research topic

The solar energy has been used since ancient times. It is the basic resource of energy reaching the earth's surface, which can be successfully used in the purification of water, air and decomposition of many different toxic compounds dangerous to the environment adsorbed at various surfaces. Can you imagine materials that do not require cleaning? Isn't this a dream of all of us? Since 1964, when Kato and Mashiko reported for the first time the possibility of decomposition of organics in the presence of titanium dioxide and UV illumination this dream has gone beyond the scope of science fiction. As soon as surfaces that are to be clean are covered by appropriate coating they became to clean themselves! This improved method of degrading organic compounds using light radiation is called photocatalysis. While the light radiation is very important aspect in this process, the TiO_2 is playing a major role, which allows converting the radiation. Titanium dioxide coatings can be deposited on various types of surfaces including glass, ceramics and metals. Such coating can also exhibit antibacterial and antifungicidal activity - properties that are important form the potential applications. Titanium dioxide has such property, that when its surface is illuminated with the light having appropriate wavelength at the presence of air and water, reactive forms of oxygen are formed that cause the removal of contaminants. Despite of many advantages such as low price, good chemical stability and non-toxicity, the activity of TiO_2 is strongly limited due to the absorption mainly in ultraviolet, which is approx. 5% of solar radiation reaching the earth's surface. Therefore, it is very important to develop a method broadening the spectrum of its photocatalytic activity to visible light.

The aim of this project is to obtain a new kind of TiO_2 photocatalyst with photonic crystal structure modified by bimetallic system of silver and platinum nanoparticles. Due to its unique structure characterized by periodically changing the refractive index and the presence of a bimetallic nanoparticles obtained photocatalyst will be extremely efficient in the UV and visible spectrum range.

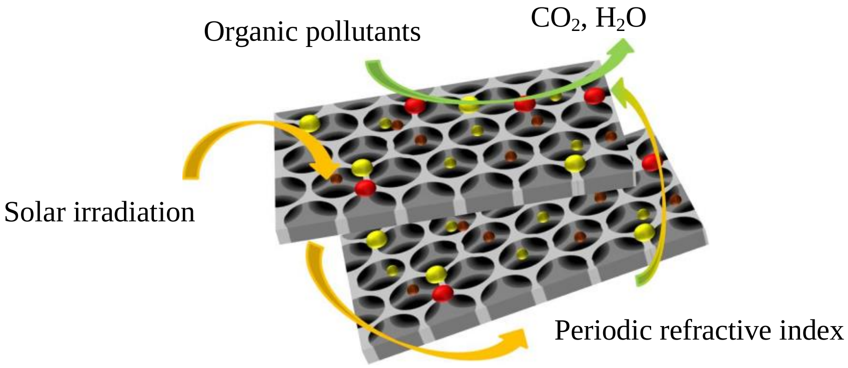

Fig. 1. Scheme of the organic pollutants decomposition occurring on the photonic crystal TiO_2 modified by bimetallic system containing silver (yellow) and platinum (red) nanoparticles.

A characteristic property of the photonic crystals structures is the presence of the photonic band gap with *'slow photon'* effect on its edges. In this case, the incident light can stay in the structure for a longer period of time and can be better utilized. If the energy of slow photon overlaps the absorbance of the semiconductor, a strong enhancement of the photocatalytic activity can be observed. The presence of bimetallic nanoparticles will slow down the recombination rate of the electron-holes pairs generated on the surface and enhance the number of reactive oxygen species. Modification by bimetallic nanoparticles will also shift the absorption activity to the visible light. The synergistic effect between those parameters will lead to new type of efficient photocatalyst.

Basic research performed during this project will elucidate the effect of the structure and bimetallic modification on the phenomenon of slow-photon effect and consequently on photocatalytic properties of investigated systems. The reason for choosing this research topic is that *'slow photon'* effect has not been thoroughly explained and described yet. Therefore the completion of this study could shed some light on the mechanism and occurrence of this phenomenon.