ABSTRACT

A hypothesis in this work was, that occurrence of *slow photon* effect (SPE) in titanium dioxide (TiO_2) photonic crystals (PCs) doped with bimetallic silver and platinum nanostructures (Ag/PtNSs) will exhibit a strong increase in the photocatalytic properties in ultraviolet and visible light in comparison with solid TiO_2. Additionally, the doping of PCs by Ag/PtNPs may affect in the shifting of electronic band gap (BG) and photonic band gap (PBG) and hence the position of SPE. The main task in this work was the study of the influence of structure and composition of PCs on their photocatalytic properties by overlapping the position of BG and occurring at the edges of PBG the *slow photon* effect.

Summarizing:

The scientific aim of this work – Preparation of the material, which exhibits overlapping of the *slow photon* effect occurring at the edges of the photonic band gap, with electronic band gap. This effect was obtained by changing the pore size of PCs and modifying by bimetallic system of silver and platinum nanostructures.

Research hypotheses – Modification of the PCs with different sizes of pores by AgPtNSs increases their photocatalytic properties and range of application due to:

- Shifting the position of BG and PBG
- Application and strengthening the *slow photon* effect
- The extension of the photoactivity to the visible light
- Longer life-time of the electrons generated in TiO_2 due to the presence of bimetallic nanoparticles

The implementation of this work and verification of the hypothesis were achieved through the design and synthesis of AgPtNSs/PCs and photocatalytic activity measurements compared to solid TiO_2 and AgPtNSs/TiO_2 coatings. This improvement was obtained due to the appearance of SPE, characteristic only for the structures of photonic crystals (PCs). The novelty in this work was the introduction of bimetallic system AgPtNSs to the structure of photonic crystals and the explanation the meaning of the impact of the *slow photon* effect in photocatalysis, which still has not been explained in details. Preparation of TiO_2-PCs structures was achieved by the formation of polymer templates in the form of polystyrene microspheres and by sol-gel method. Bimetallic nanostructures were generated by photoreduction of Ag and Pt ions 'in situ' on the surface of PCs.