Abstract

In this thesis, the possibility of energy or electron transfer in the systems containing titanium dioxide and various metallic nanostructures during photocatalytic processes is examined. The emphasis is put on the elucidation of the mechanisms of plasmonic photocatalysis and the real role of metallic nanostructures in the commonly used photocatalytic systems. It was determined that metallic nanostructures, regardless of exhibiting surface plasmon resonance in visible light or not, are responsible for the decrease of the electronic states availability in the semiconductor during growth and, therefore, change in the redox properties of modified materials. Such a change might be sometimes very significant, determining the routes and nature of processes taking place in the system. Additionally, from the nucleation step, metallic nanostructures act as the electron sinks decreasing the recombination rate and enhancing photocatalytic performance. Therefore, the universal nature of the modification of titanium dioxide with metallic nanostructures is recognized.

Moreover, the extraordinary use of plasmonic modes in photocatalysis is presented, *i.e.*, the remote photocatalysis with the propagating surface plasmon polaritons of single silver nanowires that enables excitation of the photocatalytic system without direct irradiation. Demonstration of such a possibility may open a new avenue for constructing photocatalytic systems of higher performance containing plasmonic nanostructures.