Abstract of PhD thesis of Marek Kobylański, MSC
Composites based on nanotubes obtained in electrochemical method

In this work synthesis, characteristic and photocatalytic activity of three series of composite materials were described. Ordered nanotubes obtained *via* anodization of metal foil were the matrix for each type of composites. The composites contained: i) TiO_2 and Co_xO_y nanotubes arrays;ii) Ta_2O_5 nanotubes modified by Bi_2S_3 quantum dots and iii) TiO_2 nanotubes arrays modified by platinum and PEDOT. In every series the influence of the electrolyte composite on morphology and photoactivity was investigated.

The nanotubes of TiO_2-Co_xO_y were synthesized from Ti-Co alloy. The most efficiency material was obtained from the alloy contained 85 % Ti and 15 % Co. The rates of photodegradation of aqueous phenol solution were 2.48 and 0.444 μmol·dm-3·min-1 for UV-Vis and Vis, respectively. For non-modified TiO_2 nanotubes the rates were 1.35 and 0.095 μmol·dm-3·min-1 UV-Vis and Vis, respectively. The investigation of the photodegradation mechanism confirmed that $O_2^{\bullet-}$ is mainly responsible for the decomposition of phenol solution.

Modification of Ta_2O_5 nanotube arrays to obtain TaON or TaN_3 nanostructures was carried out by annealing in NH_3 atmosphere. However, this type of modification requires high temperature and in this condition is not possible to fabricate nanostructures with high adhesion to the matrix. Therefore, other type of modification was proposed – coating Bi2S3 quantum dots on the surface of Ta_2O_5 by SILAR method. Manufactured photocatalysts characterized high adhesion to the surface and enhanced photocatalytic activity in photodegradation of toluene in gas phase.

Hybrid materials contained TiO_2 nanotube arrays, platinum nanoparticles and PEDOT were obtained in the several step synthesis. Anodization of Ti foil was the first step, subsequently radiolysis od Pt nanoparticles and finally casting of conjugated polymer. The photocatalytic activity in the model reaction of water splitting was carrying out in dependence of morphology of nanostructures. Insignificant enhanced photoactivity was observed after modification of Pt-TiO_2 nanotubes by PEDOT.