Nanocomposites $Ti/TiO_2(NTs)/X_aS_b$ as electrode materials in photoelectrochemical oxidation processes

The development of civilization contributes to the growing number of sustainable and environmentally harmful pollutants. Therefore, looking for new, environmentally friendly and effective methods for their neutralization is so important. These include photoelectrochemical methods using materials based on nanoparticles of titanium dioxide as photoelectrode. Pure titanium dioxide has high photocatalytic activity, chemical stability and it is relatively inexpensive and non-toxic. However, it is not perfect material and also has some limitations. These include, inter alia, the activity only under the influence of radiation from the UV range, which is only a few percent of solar radiation and unwanted recombination of photogenerated electron-hole pairs responsible for degradation of contaminants. This restriction can be countered through sensitization of TiO_2 semiconductor quantum dots with a smaller band gap than the band gap of titanium dioxide, such as CdS, Ag_2S, Bi_2S_3. Such nanocomposites have a higher activity under the visible radiation and reduce the recombination of electron-hole pairs.

Therefore, the proposed research aims at developing a method of synthesis of new photoelectrochemically active materials based on nanotubes of titanium dioxide, sensitized by X_aS_b quantum dots. To prepare nanocomposites $TiO_2(NTs)/X_aS_b$ (where X is Cd^{2+}, Ag^{+}, Bi^{3+}, Sn^{2+} or Pb^{2+}) serve succesive ionic layer adsorption and reaciton method (SILAR) will be used. During the tests, there will be checked inter alia, the impact of the type and concentration of the ions precursor and also the number and time of the SILAR cycles.The resulting materials will be comprehensively characterized in terms of surface structure and morphology. In addition, the project involves getting to know and clarify the relationship between the properties of the produced materials and their photoelectrochemical activity. The research will be carried out both in terms of determining the efficiency of degradation of selected pollutants as well as the mechanism of their oxidation.