Photocatalytic properties of titania dioxide (TiO_2) have been discovered at the end of the XXs century and the popularity of this material has been increased within the wide group of researchers, producents and society. TiO_2-based materials have been found to have the wide applications in many processes, such as: air and water purification, self-cleaning and antimicrobial surfaces, hydrophilic surfaces, photovoltaic solar cells, hydrogen generation in the photoelectrolytic decomposition of water, etc. Therefore many researchers are focused on the preparation of TiO_2 through the various available methods in order to receive material with an excellent properties for the selected process. So far many fundamental scientific studies have been conducted to evaluate the possibilities of commercial application of TiO_2 for decomposition of organic compounds in an aqueous and gaseous media, hover there are still some efforts put on the improvement of the yield of these processes. It is worth to underline, that the yield of the process is conditioned not only by the properties of the photocatalytic material but also by the operational conditions, such as: the source of light, temperature and relative humidity of the environment, the presence of other species in the used medium, the contact time of the reactant with the photocatalyst surface, the concentration of contaminants and a kinetic of the process. For example, in the processes of elimination of Volatile Organic Compounds (VOCs), TiO_2 is effective, but is efficacy decreases with increase the relative humidity of air above 5%. The reason is the competitive adsorption of both, water and acetaldehyde molecules to the active sites on TiO_2 surface. The water has higher affinity to the titania surface than most of the VOCs, therefore it is adsorbed on the titania surface instead of the organic compound. As a result of this, the organic compound, which is not chemically bounded with TiO_2 surface, can not follow the photocatalytic decomposition. The other disadvantage of the process connected with the photocatalytic air purification is the contact time of the organic compound with the photocatalyst surface. The scientific researches indicated on the possible increase the yield of the process by the reduction of the flowing rate of the treated gas through the reactor. For low velocity of flowing gas, such as 5-10 ml/min, the contact time is sufficient enough to facilitate the realisation of the processes such as: adsorption, diffusion to the active sites of TiO_2 surface and the photocatalytic decomposition. However in the practical application, the required low velocity of the flowing gas significantly decreases the yield of the process. In most tested and reported systems of the photocatalytic decomposition of gaseous contaminants, the photocatalyst was loaded on the stable suport and was placed inside the reactor. For such solution, the surface available for the reactant was not high enough. Therefore in this project there is proposed a novel attitude, application of fluidized reactor with a mobile bed. For that purpose, the polimer material of low density such as 10-14 kg/m^3 can be utilized, for example the small size and spherical shaped polystyrene or polyurethane foams. In that way the interaction between the photocatalyst surface and the contaminant present in the inlet stream can increase. Moreover, this contact will be forced by the direction of the flowing gas. The preparation of the fluidized bed will consist from two steps: coating of polymer spheres with SiO_2 layer and then coating with an additional thin layer of TiO_2. SiO_2 layer will have two functions: (1) as a protective layer against degradation of polymer, which can occurr at the presence of UV light and direct contact with TiO_2; (2) adsorption layer for water molecules, because SiO_2 has strong hydrophilic properties. Such combination of two layers can protect TiO_2 from deterioration of its photocatalytic properties at the conditions of high air humidity. Additional benefit of such solution is increase of the material porosity due to the porous structure of SiO_2. The other problem to solve, which will be undertaken within realisation of this project is minimization of the concentration of the byproducts in the outlet gas stream, which are formed upon photocatalytic oxidation and can be sometimes more toxic than the treated contaminants. It was already proved, that in case of acetaldehyde decomposition at the conditions of weak UV light, the acetic acid and formaldehyde were formed as byproducts, which both were a result of incomplete mineralization. The complete decomposition of acetaldehyde can be obtained through modification of TiO_2 with metal nanoparticles, such as Pt. In that case all the deposited byproducts on titania surface are burned through combination of photocatalytic and thermo-photocatalytic processes. In the proposed project it is planned modification of hybrid SiO_2/TiO_2 layers through coating with metal nanopartciles such as Pt, Ag, Cu and others to investigate the process of thermo-photocatalysis and its impact on the mineralisation degree of VOCs. For the photocatalytic processes UV LEDs lamps of low energy consumption will be utilized. The proposed studies in this project allow to solve some of the present problems connected with application of the photocatalytic cleaning process of air from gaseous VOCs such as: high air humidity, formation of toxic byproducts, deactivation of photocatalyst and low efficiency of the process caused by the long contact time of pollutant with the photocatalyst surface.