Abstract

The aim of this dissertation was to prepare and carry out test materials based on TiO_2 in order to use them as photoactive materials for self – cleaning surfaces. Photocatalytic activity tests were carried out for the model compound acetaldehyde. The sol-gel method was used for the preparation, using titanium (IV) isopropoxide as a precursor and also was used an intermediate from the production of titanium - white titanium pulp, which was subjected to thermal treatment and modification with ammonia. For comparison, photocatalytic properties were also tested commercial products, i.e. TiO_2 from Evonik (P25 and P90) and TiO_2 from KRONOS (Kronos 7000 and Kronos 7050). The materials were tested as a thin film applied to the surface of glass plates. Photocatalytic tests have shown that the activity of TiO_2 increases with the increase of its crystallinity, but then decreases with the increase of anatase crystallites and decrease of BET surface area. It has been proved that the presence of two phases of TiO_2, i.e. anatase and brookite and anatase and rutile, improves the separation of charge carriers and increases their photocatalytic activity. The doping of titanium with nitrogen on the one hand increases the separation of charge carriers, but on the other hand leads to an increase the hydrophilicity of the sample surface and then its photocatalytic activity decreases. On the example of titanium pulp, it has been found that almost complete removal of water from the bulk takes place at a temperature of about 450°C. Dehydroxylation of the surface and the transition of amorphous titanium to a crystalline form are key to obtaining active TiO_2 based photocatalysts, which is why the most active samples were prepared at 400 and 450°C. It was proved that more negative electrokinetic potential of the TiO_2 surface is unfavorable for the photocatalytic decomposition of acetaldehyde, therefore TiO_2 having surface defects in the form of oxygen vacancies (after modification with ammonia) or modified with tungsten compounds, which increased the acidity of the surface, turned out to be less effective for the decomposition of acetaldehyde than pure TiO_2. Carbon – modified samples were more active than those modified with ammonia, but showed greater transformation to the intermediate product, which was formaldehyde compared to other TiO_2 samples. In addition, the doped carbon was decomposed during exposure. It has been proven that while nitrogen - doped TiO_2 shows visible light activity, it shows less photocatalytic activity than pure TiO_2 during irradiation with a fluorescent lamp. Thus, even a small fraction of the UV radiation emitted by the fluorescent lamp is sufficient for the activation of TiO_2 and the efficient decomposition of low - concentration acetaldehyde, i.e. 300 ppm.

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