Paulina Rokicka – PhD thesis abstract : "TiO_2/C photocatalysts – preparation, characterization and application in water disinfection".

The aim of PhD thesis was preparation of a new photocatalysts modified by monosaccharides (D-fructose and D-glucose) and disaccharide (sucrose) with increased usability for water disinfection under solar light irradiation. The intermediate product, taken directly from the production line of titanium dioxide, from the Grupa Azoty, Zakłady Chemiczne Police S.A was used as the starting material in the process of photocatalysts preparation. Titanium dioxide was treated with sugar solutions of various concentrations (1, 5, 10%) at various anneling temperature (range from 100 to 800°C). Thirty new TiO_2/C photocatalysts were obtained. The impact of preparation (modification) conditions (e.g. type of sugars, sugar concentration, temperature) on physicochemical properties of photocatalysts was analyzed. The *best properties* were achieved when 1% solution of fructose, glucose and sucrose (anneling temperature 100°C) were used for modification and this group of photocatalysts was selected for further microbiological studies.

The antibacterial properties of C/TiO_2 photocatalysts against *Escherichia coli* bacteria ACCT 25922 (Gram-negative bacteria) and *Staphylococcus epidermidis* ACCT 49461 (Gram-positive bacteria) under UV-A and UV-VIS (artificial solar light) irradiation were examined. The disinfection efficiency through the addition of experimentally determined photocatalyst's dose (0.1 g × dm^{-3}) and bacteria concentration (from 1.0×10^6 CFU × cm^{-3} to 1.5×10^6 CFU × cm^{-3}) was tested. The effect of TiO_2/C on the bacterial survival rate, activity of oxidative stress enzymes (catalase and superoxide dismutase) and mineralization rate was investigated. The practical application of TiO_2-G-1%-100 as a component of cementitious material were studied.

Based on obtained results it was noted that modification of titanium dioxide by carbon derived from fructose, glucose or sucrose led for obtaining photocatalysts exhibited higher visible light absorption. The photocatalyst obtained by modification of titanium dioxide by 1% solution of fructose, glucose or sucrose (heated at 100°C) consisted mainly of anatase phase (from 97.6 to 97.9%). Photocatalysts were characterized by large surface area (264 – 268 $m^2 \times g^{-1}$) and small crystallite size of anatase (11.4 – 11.7 nm). In comparison with starting material, unmodified TiO_2 heated at 100°C, commercial P25 and KRONOClean photocatalysts, the antibacterial properties of TiO_2/C photocatalysts (against *E. coli* and *S. epidermidis*) was better. It was found that carbon content was the main factor influencing antibacterial activity of photocatalysts. The carbon-doping (0.51 to 0.59) resulted in modified

surface properties (e.g. zeta potential and amounts of generated •OH radicals) and increased bacterial adhesion to photocatalyst. Under the solar irradiation, time required for photocatalytic disinfection of TiO_2-F-1%-100,TiO_2-G-1%-100 suspensions should not be shorter than 70 minutes. After immobilization in concrete, extend of disinfection time (up 120 min) should be taken into consideration.

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