Novel TiO2/g-C3N4 photocatalysts for photocatalytic reduction of CO2 and for photocatalytic decomposition of N2O

P. Praus[1,2], **M. Reli**[1], **P. Huo**[1], **M. Šihor**[1,2], **I. Troppová**[1], **L. Matějová**[1], **L. Svoboda**[1,2], **L. Čapek**[3] , **V. Matějka**[2] and **K. Kočí**[1,2]
[1]IET, VŠB-Technical University of Ostrava, Czech Republic
[2]FMMI, VŠB-Technical University of Ostrava,Czech Republic
[3]FCHT, University of Pardubice, Studentská Czech Republic

Heterojunction TiO2 and graphitic carbon nitride (TiO2/g-C3N4) photocatalysts with the ratio of TiO2 to g-C3N4 ranging from 0.3/1 to 2/1 were prepared by simple mechanical mixing of pure g-C^3N^4 and commercial TiO2 Evonik P25 and calcination at 450 oC for 2 hours. Graphitic C_3N_4 was previously synthetized by heating of melamine in a muffle furnace at 550 for 2 hours. All the nanocomposites were characterized by X-ray powder diffraction, UV−vis diffuse reflectance spectroscopy, photoluminescence, X-ray photoelectron spectroscopy, Raman spectroscopy, infrared spectroscopy, transmission electron microscopy, photoelectrochemical measurements, and nitrogen physisorption (the BET method). The prepared nanocomposites along with pure TiO2 and g-C_3N^4 were tested for the photocatalytic reduction of carbon dioxide and the photocatalytic decomposition of nitrous oxide. The pure g-C_3N_4 exhibited the lowest photocatalytic activity in both cases, pointing to a very high recombination rate of photoinduced electron and holes. On the other hand, the most active photocatalyst toward all the products was (0.3/1)TiO2/g-C_3N_4. The highest activity was achieved by combination of a number of factors: (i) specific surface area, (ii) adsorption edge energy, (iii) crystallite size, and (iv) efficient separation of the electrons and holes, where the efficient charge separation is the most decisive parameter. Based on the obtained results, it can be assumed that the semiconductor nanocomposites formed between g-C_3N_4 and TiO_2 can have potential applications for photocatalytic reactions employed in environmental remediation. This work was supported by the Czech Science Foundation (project No. 16-10527S).

Biography

Petr Praus has completed his PhD in the field Analytical Chemistry at the University of Pardubice, the Czech Republic, in 1995. Since 2002 he has been working as full professor in the field of Material Sciences and Engineering at the VŠB-Technical University of Ostrava, the Czech Republic. He has been working in the fields of synthesis and applications of nanomaterials and development and applications of analytical methods. He has published more than 60 papers in the reputed journals with impact factors.

petr.praus@vsb.cz

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