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Matějová, Lenka
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Sol-gel derived Au-enriched TiO₂ and TiO₂-ZrO₂ photocatalysts and their examination in photocatalytic reduction of carbon dioxide

L. Matějová^{1,3}, M. Reli¹, L. Čapek², V. Matějka¹, O. Šolcová³, L. Obalová¹, K. Kočí¹

¹VŠB-Technical University of Ostrava, Czech Republic;

²University of Pardubice, Czech Republic;

³Institute of Chemical Process Fundamentals of the ASCR, v. v. i., Czech Republic

lenka.matejova@vsb.cz, matejova@icpf.cas.cz

Since Fujishima and Honda in 1972 reported in Nature on the electrochemical photolysis of water at a semiconductor electrode [1], namely the split water into hydrogen and oxygen in the presence of TiO₂ electrode under VUV light irradiation, the scientific interest in the heterogeneous photocatalysis over semiconductors has dramatically raised. From the group of semiconductors TiO₂ has been stood in the forefront of scientific research. Researches have started keenly investigate the positive effect of various forms (i.e. nanoparticulate powders and thin films) of TiO₂ for various applications, e.g. degradation of organic pollutants in air and water, sensing films of gas sensors, coatings for self-cleaning surfaces, an electrode material or a support of noble metal catalysts. The development of highly efficient TiO₂-based photocatalysts, which would be reactive even under solar light irradiation, has become a challenge and a subject of current intense research.

Considering the aspects of preparation of gold-based photocatalysts and gold photocatalysis, it is worth a mention that it is more complicated issue than in the case of other noble metals due to the gold crystallinity. In this contribution some critical aspects of the gold photocatalysis will be discussed. Au-supported TiO₂ and TiO₂-ZrO₂ photocatalysts and their pristine counterparts were prepared by using the sol-gel process controlled within reverse micelles environment and by impregnation under vacuum. All photocatalysts were characterized by organic elementary analysis (OEA), inductively coupled plasma mass spectrometry (ICP MS), N₂ physisorption, powder X-ray diffraction (XRD), transmission electron microscopy combined with electron diffraction (TEM/SEAD) and UV-Vis spectroscopy. The performance of laboratory-prepared photocatalysts was examined in CO₂ photocatalytic reduction and was compared with the catalytic performance of commercial TiO₂ Evonic P25. Logically, the determined physicochemical and optical properties of photocatalysts were correlated with their catalytic performance and some interesting aspects of gold photocatalysis were revealed.

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References:

[1] A. Fujishima, K. Honda, Nature 238 (1972) 37-38.

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