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Sol-gel derived Au-enriched TiO_2 and TiO_2-ZrO_2 photocatalysts and their examination in photocatalytic reduction of carbon dioxide

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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 TiO_2 electrode under VUV light irradiation, the scientific interest in the heterogeneous photocatalysis over semiconductors has dramatically raised. From the group of semiconductors TiO_2 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 TiO_2 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 TiO_2-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 TiO_2 and TiO_2-ZrO_2 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), N_2 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 CO_2 photocatalytic reduction and was compared with the catalytic performance of commercial TiO_2 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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