Photocatalytic activity of $Ti_{1-x}M_xO_2$ (M = Co and Cr) crystals

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Metal-doped TiO_2 nanoparticles were prepared by the sol-gel and hydrothermal synthesis methods. The estimated quantum yields (QYs) of Pt/Cr-doped TiO_2 nanoparticles was ca. 0.3 %. Cr- , Co- and N-doped TiO2 showed the photocatalytic activity for IPA degradation to CO_2, but only Cr-doped TiO_2 produced H_2 photocatalytically in the presence of methanol-water aqueous solution under visible light (> 420nm). Thus, in the case of Pt/Co-doped TiO_2, the electron excited to the conduction band has a sufficient reduction potential to reduce H+ ion, but hole in the valence band has lower oxidation potential than required for CH_3OH degradation to CO_2. Therefore, Cr- , Co- and N-doped TiO_2 show the different activity for the photocatalytic reaction of gases and solution phases. The results of the calculated electronic structure and experimental optical properties are correlated to schematically to describe the possible mechanism of the photocatalytic behavior of the system under study.