第217回触媒化学研究センター談話会

演題: Researches on Photocatalysts in the Ecomaterials and Renewable Energy Research Center of Nanjing University

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日時: 2007年8月29日(水)13:30－15:00

会場: 北海道大学創成科学研究棟4階セミナー室B・C

The concept of using solar energy to solve the global energy and environmental problems has been intensified from the standpoints to a technological assessment, since the energy and environmental issues in a global level are important themes tackled in the 21st century. The photocatalytic decomposition of water with a semiconductor under visible light attracts increasing interest because the attempt is aimed not only at producing hydrogen from water utilizing solar energy, but also at finding methods of making use of the photosynthetic process as green plants for direct production. In this talk, I will introduce advance and development of photocatalysis and hydrogen energy research in our group for the relative research project. Recently, we found some new series of oxide semiconductor photocatalysts: $AgAlO_2$, $Bi_2O_3/SrTiO_3$ and $Ti_{1-x}Zr_xO_2$ solid solutions. These photocatalysts have different crystal structure, leading to different electronic structures. The new photocatalysts were synthesized by the solid state reaction and sol-gel method. Their photocatalytic degradation of organic contaminants were investigated systematically, by selecting acetaldehyde as a model gaseous contaminant, chloroform as a model solvent contaminant and methylene blue (MB) as a model dye contaminant, respectively. The photocatalytic decomposition of these contaminants was investigated under visible light irradiation using a Xe lamp or fluorescent lamp with cut-off filters of different wavelength at room temperature. It was found that the new photocatalysts showed a high activity for acetaldehyde decomposition and MB degradation in a wide wavelength range of visible light up to 640nm. Understandings on the relations among the materials syntheses, photophysical properties, and photocatalytic activities of these new photocatalysts obtained by various experimental measurements and theoretical calculations will be discussed. Improvement of photocatalytic activity by surface modification will also be reported. And we found also some new photocatalysts: $LiNbO_3$, Ca_2NiWO_6, $CoTa_2O_6$ and Bi_2GaTaO_7. These photocatalysts were found to split water into H_2 and/or O_2. We have demonstrated the surface characteristics of these photocatalysts. One of the most important key factors for increasing activity might be to suppress the recombination of separated electron and hole by excitation of photon. Our results showed that the catalytic efficiency of the photocatalyst could be improved by increasing its crystallinity and suitable modification of the surface sites. The photocatalytic activity increases significantly by loading co-catalysts on the surface of the photocatalyts, such as NiO, RuO_2 and Pt.

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