第325回触媒化学研究センターコロキウム

共催　電気化学会北海道支部

Photoactive nano-materials in environmental engineering

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Seminar Room B, Sousei Hall, Hokkaido University

（創成科学研究棟4階セミナー室B）

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Two types of photoactivie material will be discussed: (1) vertically ordered TiO_2 nanotube arrays synthesized by anodic oxidation of titanium foil and (2) TiO_2 loaded with bimetallic nanoparticles (Au/Pd) obtained by microemulsion method.　In the first part of lecture, the effect of electrolyte composition, anodization voltage, ultrasonic treatment and calcination time on the morphology of the resulting TiO_2 nanotube arrays, as well as on their photocatalytic activity in toluene removal, used as a model volatile organic compound, will be presented. The stability of such obtained thin film in four subsequent cycle will be also shown. TiO_2 nanotube arrays are effective in gas phase treatment using low powered irradiation sources, e.g. LEDs but photocatalytic activity of TiO_2 NTs strictly depend on nanotubes morphology (length of tubes, top-opened or clogged and wall smoothness). The highest photoactivity in toluene degradation reaction could be observed for longer (4.3-μm-and 5.9-μm-long nanotube arrays) obtained by Ti-foil anodization in ethylene glycol-based electrolyte. Prolonged calcination steps resulted in decrease of photoactivity due to increase of crystallite size and appearance of rutile phase.　In the second part of lecture, the effect of calcination temperature (from 350 to 700°C) on the structure and properties of TiO_2 loaded with Au/Pd nanoparticles will be presented. The structure of bimetallic nanoparticles will be correlated with preparation route, photoactivity in phenol degradation under UV and visible light as well as a formation of radical species detected by EPR technique. The STEM analysis indicated that the structure of Au/Pd nanoparticles deposited at the TiO_2 surface changed with increase of temperature from 350 to 700°C. In the case of nanoparticles calcined at 350°C, the core is rich in Au and Pd (Au:Pd=1:2), and the shell contained mostly palladium (Au:Pd=1:23). Increasing the temperature up to 400°C caused the segregation of the metal and increases nanoparticles size. The EDS mapping showed that the Au and Pd were randomly distributed on the surface of TiO_2 and the ratio of gold to palladium was higher in both shell and core region. The ratio of gold to palladium varied from 1:5 to 1:11 for the sample calcined at 450°C. Thus, the increase of calcination temperature caused re-distribution and segregation of Au/Pd bimetallic nanoparticles and EDS mapping showed that the shell region is enriched in gold with increasing temperature.

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Hokkaido Branch of Electrochemical Society of Japan