

Photocatalytic properties of zinc oxide whiskers prepared from organic-zinc

K. Haga^{a,*}, H. Watanabe^a, B. P. Zhang^b, Y. Segawa^b, H. Saito^c

^a*Sendai National College of Technology, Sendai, 989-3124, Japan.*

^b*Photodynamics Research Center, RIKEN, Sendai, 980-0868, Japan.*

^c*Tohoku Ricoh Co., Shibata, 989-1695, Japan.*

Zinc oxide nanomaterials such as whiskers or nanowires fabricated without photolithographic techniques are expected to be applied in such as nanoscale electronic and photonic devices due to their unique characteristics. ZnO has also great potential in application for photocatalytic materials that eliminate environmental pollution. We have successfully prepared microstructure zinc oxide whiskers with a high photocatalytic efficiency in visible light by a novel method using $\text{Zn}(\text{C}_5\text{H}_7\text{O}_2)_2$. The whiskers were of 30 – 200 μm in diameter and around 1000 μm in length. The preparation method is very simple and promising in terms of high volume production. $\text{Zn}(\text{C}_5\text{H}_7\text{O}_2)_2$ was vaporized in a Pyrex tube and then re-crystallized at the cooled part as whiskers. The $\text{Zn}(\text{C}_5\text{H}_7\text{O}_2)_2$ crystals with whisker structure were oxidized successively in an atmosphere of water vapor for 2 hours at RT – 200°C and then of oxygen for 1 hour at 400 – 800°C.

The crystal orientation and the surface morphology of the whiskers were analyzed by X-ray diffraction and scanning electron microscope, respectively. The full width at half maximum of the highest ZnO (10 $\bar{1}$ 1) peak at $2\theta = 36.28^\circ$ decreased from 0.49 to 0.20° with increasing thermal oxidation temperature at 400 to 800°C.

The photocatalytic decomposition of NO₂ was observed in a quartz tube reactor. The reactant gas was NO₂ (5 ppm in N₂) and highly purified air while controlling the water partial pressure. The samples were irradiated by a commercially available fluorescent lamp in the visible region. The concentration of NO₂ was measured using a cross-flow modulated semi-decompression chemiluminescence method. We found that the photocatalytic activity of the ZnO whiskers was superior to that of a conventional TiO₂ photocatalyst under visible light irradiation.

* Corresponding author. Tel. +81-22-391-5599. FAX +81-22-391-6144.
Email address: haga@cc.sendai-ct.ac.jp (K. Haga).