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Modification of Titanium Dioxide Nanoparticles with Copper Oxide Co-catalyst for Photocatalytic Degradation of 2,4-Dichlorophenoxyacetic Acid

Leny Yuliati[1]*, Wai Ruu Siah[1], Nur Azmina Roslan[2], Mustaffa Shamsuddin[2], Hendrik O. Lintang[1]

[1] Ibnu Sina Institute for Fundamental Science Studies, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
[2] Department of Chemistry, Faculty of Science, University Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

Corresponding author email: leny@ibnusina.utm.my

2,4-Dichlorophenoxyacetic acid (2,4-D) is a common herbicide that has been used in control of broadleaf weeds, wheat, corn, pastureland, lawn, recreational lakes, turf, and roadsides. Due to it excessive usage, these herbicides that contained 2,4-D can cause contamination over agricultural land and water bodies. Photocatalytic removal of environmental pollutants such as herbicides has been a topic of great interest over the years[1]. One of the most widely used materials for photocatalytic degradation of environmental pollutants is TiO_2. A number of strategies have been developed in order to improve the catalytic activity of TiO_2 photocatalyst. In particular, it has been shown that transition metal oxides, such as copper oxide, are potential to enhance the photocatalytic activity of TiO_2[2,3]. In the present work, a simple impregnation method was used to modify the commercial P25 TiO_2 nanoparticles with the copper oxide. The prepared samples were characterized by XRD, reflectance UV-visible and fluorescence spectroscopies. It was observed that the incorporation of copper oxide did not significantly affect the crystal structure of TiO_2. On the other hand, the presence of copper oxide was confirmed by reflectance UV-visible and fluorescence spectroscopies.

Figure 1 shows the photocatalytic removal of 2,4-D on bare TiO_2 and modified TiO_2 nanoparticles. It can be clearly shown that after 1 hour reaction, the photocatalytic activity of TiO_2 increased from 48 to 54% with the increase of copper oxide loading up to 0.5 mol%. Unfortunately, the higher loading amount of copper oxide resulted in the lower photocatalytic activity. When the loading amount was 5 mol%, the activity decreased to 26%. This result clearly suggested that the small amount of copper oxide, which was 0.5 mol%, was the optimum amount in this study to give the highest activity for the copper oxide supported on TiO_2 series. The higher photocatalytic activity would be originated from the lower electron-hole recombination.

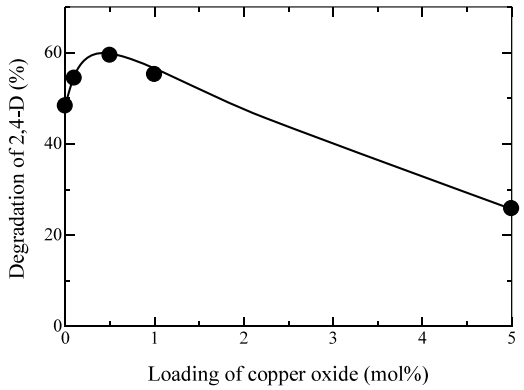

Figure 1. Photocatalytic removal of 2,4-D on bare and modified TiO_2 samples.

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Dr. Leny Yuliati
Universiti Teknologi Malaysia, Malaysia
Phone: +60 75536272 Fax: +60 75536080
E-mail: leny@ibnusina.utm.my
Research interests: Heterogeneous catalysis and photocatalysis, sensor materials

1996-2000	B.Sci. (Chemistry) Gadjah Mada University, Indonesia
2003-2005	M.Eng. (Applied Chemistry) Nagoya University, Japan
2005-2008	D. Eng. (Applied Chemistry, Chemical Engineering and Biotechnology) Nagoya University, Japan
2008-2010	JSPS Fellow Researcher at the University of Tokyo, Japan
2010-present	Senior Lecturer at Universiti Teknologi Malaysia, Malaysia