Topic: Photocatalytic Degradation of Formaldehyde on Adsorptive Graphene/TiO_2 Photocatalyst for Car Interior Air Cleaning

Name of student: Mr. Wasu Low **Student ID:** 53980101

Name of Supervisor: Assoc. Prof. Dr. Virote Boonamnuayvitaya

ABSTRACT

In this work, graphene–TiO_2 (GR–TiO_2), graphene/Fe^{3+}–TiO_2 (GR/Fe^{3+}–TiO_2) and graphene/Ag_2S–TiO_2 (GR/Ag_2S–TiO_2) photocatalysts were synthesized in order to increase the photocatalytic activity of TiO_2. Refluxed peroxo titanic acid (PTA) solution was used as a starting material for TiO_2 preparation. Hummer's method was used to synthesize graphene oxide. Graphene oxide can be further converted to graphene by UV irradiation. The chemical reaction between silver acetate and thiourea was used to prepare Ag_2S. The photocatalytic degradation of the prepared photocatalysts was examined under ultraviolet (UV) and visible light irradiation. The results showed that GR–TiO_2, GR/Fe^{3+}–TiO_2 and GR/Ag_2S–TiO_2 exhibited larger photocatalytic activity than that of TiO_2. The increase in photocatalytic activity of GR–TiO_2 was attributed to the increase in adsorption capacity, prevention of charge recombination and the extension of light absorption in the visible light region. In the case of Fe^{3+} dopant, the photocatalytic activity of GR/Fe^{3+}–TiO_2 was due to the chemical redox reaction of Fe^{3+}. The photocatalytic activity of GR–TiO_2 was also improved by adding Ag_2S sensitizer. However, it was obvious that GR/Fe^{3+}–TiO_2 (0.12 wt% Fe^{3+}) exhibited larger photocatalytic activity that other catalysts. The effect of formaldehyde (HCHO) concentration, relative humidity and visible light intensity was examined using a glass chamber reactor as a simulation of inside environmental vehicle conditions. It was noted that GR/Fe^{3+}–TiO_2 (0.12 wt% Fe^{3+}) photocatalyst can degrade HCHO with average degradation efficiency of 20–80% under outdoor sunshade irradiation.

Keywords: Formaldehyde, Ferric ion (Fe^{3+}), Graphene, Photocatalyst, Silver sulfide (Ag_2S), Titanium dioxide (TiO_2)