Decomposition of indoor gaseous toluene using photocatalytic reactor

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ABSTRACT

In the present study, indoor level of gaseous toluene was decomposed by TiO2-based visible light photocatalyts among which TiO2 thin film was synthesized via a sol-gel method by using Titanium tetraisopropoxide (TTIP) as the precursor following by dip-coating process. In the Phase 1 study, the experiments were conducted in a bench scale glass cylindrical reactor illuminated by 300-400 nm UV light. The results indicated that low concentration of gaseous toluene was decomposed significantly by using TiO2 thin film prepared from both degussa P25 and TTIP. As the initial toluene concentrations were varied from 0.5 ppm to 6 ppm, the overall decomposition rate for UV-illuminated Degussa P25 was decreased approximately from 88% to 8%. As a comparison, sol-gel TiO2 films prepared from TTIP showed more efficient photocatalytic ability under extremely low concentration at which 2 ppm toluene were decomposed completely at the gaseous flow rate of 200 mL min-1. In the Phase 2 study, dye-sensitized TiO2 photocatalysts were tested under visible light illumination. The experimental results showed that dye-sensitized TiO2 photocatalysts prepared from TTIP can work under visible light illumination but its removal efficiency was not high. It was approximately 35% for toluene at 0.5 ppm. The results also indicated that dye-sensitized P25 with acid treatment can decompose low concentration of gaseous toluene and its removal efficiency was approximately 48% for toluene at 0.5 ppm but dye-sensitized P25 without acid treatment only works under UV-illuminated conditions. The commercial photocatalyst of Ag/TiO2 was also tested but the results indicated that it almost can not decompose gaseous toluene at low concentration under visible light illumination.

Keywords : indoor air; photocatalytic; dye-sensitized TiO2; toluene; visible light

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