

Photocatalytic elimination of organic chemicals and aerosol-associated influenza virus infectivity in the air

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Abstract

The efficiency of photocatalysis depends on the surface area and materials, and we have prepared a nanosized-titanium dioxide (TiO₂)-coated ceramic irradiated by UV-LED lamps as a photocatalytic air cleaner. Ceramic filter system decomposed 80% of acetaldehyde and Particulate dioxins (40 pg/m³) and gaseous dioxins (16 pg/m³) were removed by 7.5 and 2.8 pg/m³ by passing through four TiO₂-coated ceramic (30 × 30 × 2 cm) under black-light, indicating about 80% of dioxin was decomposed by the photocatalysis. Ceramic was changed to aluminum plate and the efficiency was improved. The 90% of 5 ppm acetaldehyde (12.4 μmol/h) was decomposed and generated carbon dioxide (25.43 μmol/h; RC: 92.5% carbon dioxide conversion rate) efficiently and continuously for 200 min with the ratio of one acetaldehyde (12.40 μmol/h) to two carbon dioxide (25.43 μmol/h) at their molar ratios by being passed through the TiO₂-coated aluminum plate (5 × 10 × 1 cm) under black light, indicating complete decomposition of acetaldehyde with high efficiency. This photocatalysis system was applied for elimination of acetaldehyde and inactivation of influenza aerosol in a closed cubic space using aluminum plates. Acetaldehyde at 20 ppm in a cubic 1 m³ space was eliminated by 60 min at a half-life of 8 min. The aerosol-associated infectivity and the RNA genome of influenza virus produced by a nebulizer in a 779 liter cubic space were eliminated within 7 minutes but were detectable up to 28 minutes without the function of a photocatalytic air cleaner. Influenza virus was broken down by photocatalysis rather than being trapped by Hepafilter as intermediate breakdown products of influenza virus were observed. Thus, a photocatalytic air cleaner efficiently decomposed and eliminated organic chemicals, acetaldehyde, and aerosol-associated influenza virus infectivity and viral RNA, indicating a photocatalytic air cleaner functioned in the cleaning and detoxification of the air in the closed space for maintaining a safer environment.

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