A trial of photocatalytic decomposition of polycyclic aromatic hydrocarbons in diluted engine exhaust gas

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To develop a photocatalytic air purifier usable at highly polluted roadside places, the decomposition by photocatalyst of polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) in diluted engine exhaust gas was examined.

Exhaust gas from a small four-cycle gasoline engine for power generation was diluted with pure air, treated with a polymer filter, and then introduced into a flow-type photocatalytic reactor. Inside this reactor, nineteen calcium silicate plates (5 cm x 10 cm) coated with titanium dioxide (Degussa P25) were continuously set on a conveyer for transferring plates. Two 40 W ultraviolet light lamps were used for irradiation (light intensity: 4 5 mW/cm^2). The concentration of PAHs and VOCs in the gas phase before and after passing the reactor was measured using a real-time PAH monitor (Ecochem Analytics, PAS 2000CE) and a VOC monitor (RAE systems, Model PGM-7240), respectively. Furthermore, the amount of remained PAHs on photocatalytic plates with and without photoirradiation was analyzed to estimate the extent of PAHs loss by photocatalytic decomposition.

The results showed that PAHs in diluted exhaust gas were not decomposed in a photocatalytic reactor. We guess that most of PAHs entered inside the reactor are particle-bound ones, which are stable against photocatalytic decomposition. We previously observed stable character of PAHs in particles. This may be due to low rate of contact between PAHs and photocatalyst. Therefore, the use of high-performance polymer filter or improvement of contact efficiency between PAHs and photocatalyst is needed for the removal of particle-bound PAHs in air. On the contrary, the concentration of VOCs decreased by passing the photocatalytic reactor.