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Performance Test of Nitrogen Oxide Reduction of TiO_2 Photocatalyst Coating Materials

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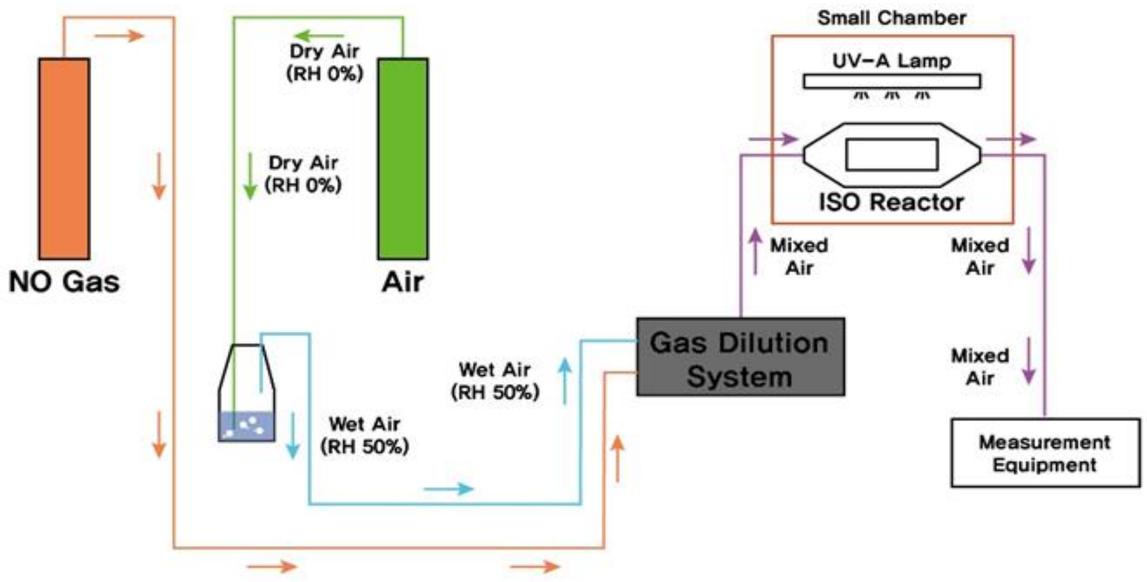
1. Introduction

Recently, the concentration of particulate matter in Korea has gradually increased and is recognized as a national problem, and the government is making great efforts to reduce the level of particulate matter pollution. The sources of particulate matter are divided into primary and secondary sources. Secondary source is generated through the chemical combination of pollutants present in the gas and light bulb present in the atmosphere among primary pollutants. Nitrogen oxide (NOx) is a representative bulb material and a typical way to remove it is by utilizing TiO_2.

2. Experimental Methodology

In this study, TiO_2 photocatalyst NOx reduction performance experiments were conducted in two ways: First, the ISO 22197-1 standard test measured the change in NO, NO_2, and NOx concentration according to ON/OFF of UV-A ultraviolet light lamps while maintaining the conditions of 1.00 ppm and 10W/m^2 of UV-A ultraviolet light in the chamber continuously for three hours.

Second, the condition change experiment was conducted to confirm the change in NOx reduction performance of TiO_2 photocatalysts through UV-A light volume (5.00 W/m^2, 2.50 W/m^2) and NO concentration change (0.25 ppm, 0.50 ppm).

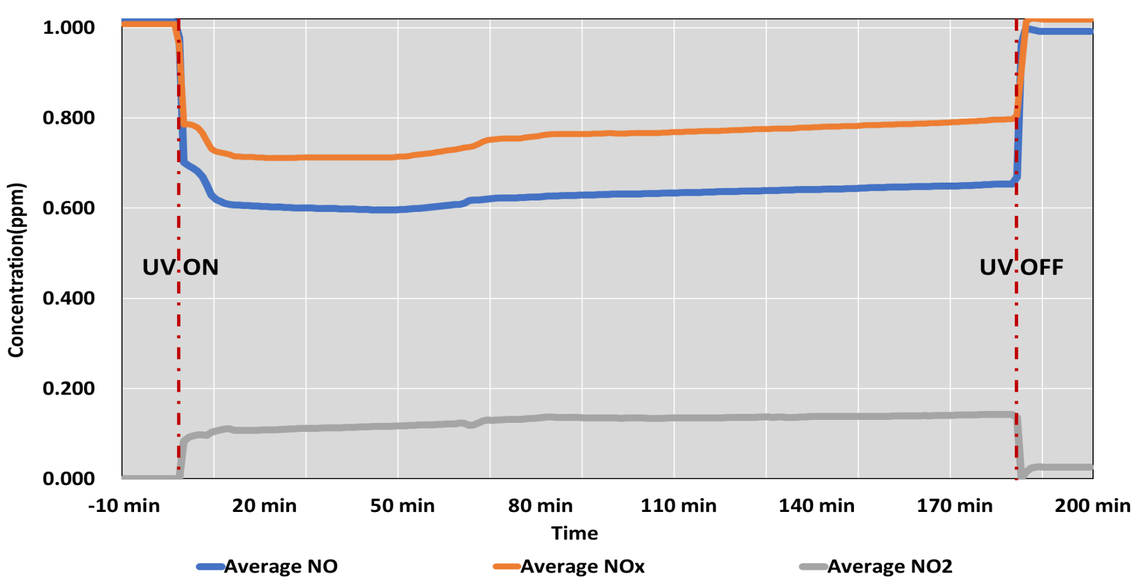


Test chamber diagram

3. Results

Experiments applying the ISO 22197-1 standard conditions (1.00 ppm, 10.0 W/m^2) showed that the concentration of NOx decreased from 1.00 ppm to about 0.800 ppm when the UV lamp was on.

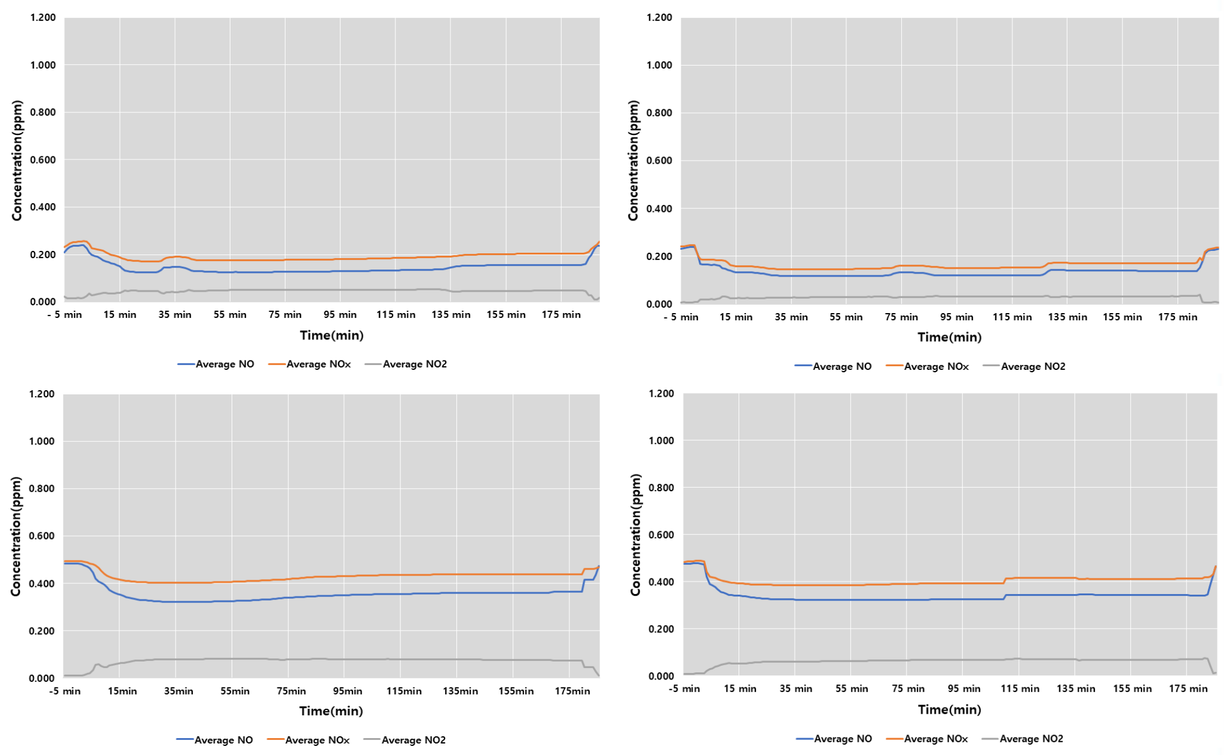
The results of the experiments with changes in UV-A light mass and NO concentration showed that a constant concentration of NO resulted in an increase in reduction due to an increase in light volume. This is judged to increase the activity of TiO_2 photocatalysts due to increased wavelength energy due to increased UV-A light volume. For low concentration NOx, it can be found that the factor affecting the activity of the TiO_2 photocatalyst is UV-A.



ISO standard condition NOx reduction result

ISO standard condition Test result

Classification	Start Concentration	End Concentration	Reduction rate
NO	1.015 ppm	0.653 ppm	35.67 %
NO_2	0.000 ppm	0.143 ppm	Generate
NOx	1.008 ppm	0.796 ppm	21.03 %



Condition change NOx reduction test

ISO standard condition test NOx reduction result

ppm / W/m^2	Concentration difference(c=a-b)	
	0.25 ppm	**0.50 ppm**
2.50 W/m^2	0.067 ppm	0.074 ppm
5.00 W/m^2	0.080 ppm	0.076 ppm

4. Conclusions

This study analyzed concentration reduction performance by TiO_2 photocatalyst and UV-A ultraviolet reaction as a way to reduce NOx among materials that precursor particulate matter.

First, the ISO 22197-1 experiment confirmed that the TiO_2 photocatalyst coating reduced NOx by about 8.95 μmol/10cm^2·3h.

Second, the performance trend of NOx reduction due to UV-A light volume and NO concentration changes was determined to be about 2.81 μmol/10cm^2·3h under conditions of 0.25 ppm and 2.50 W/m^2 UV-A light. In addition, the reduction was 3.23 μmol/10cm^2·3h under the conditions of 0.50 ppm NO concentration and 5.0 W/m^2 UV-A light.

Third, the NOx reduction efficiency of TiO_2 photocatalysts is judged to have a greater effect on UV-A light volume than NO concentration for low concentration NOx. The stronger the UV-A wavelength strength, the more likely the TiO_2 oxidation reaction is to have a greater effect on the NOx reduction efficiency.

Therefore, in the case of coatings applied with TiO_2 photocatalysts applied to this study, the coatings applied with TiO_2 photocatalysts can reduce NOx even in the general environment, confirming the possibility of use as a method for reducing fine dust bulb materials.

5. Acknowledgement

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