

TEST REPORT

Determination of the air purification performance of semiconducting photocatalytic materials by removing nitric oxide in accordance with ISO 22197-1

On behalf of:

Deutsche Steinzeug Cremer & Breuer AG

Servaisstraße

53347 Alfter-Witterschlick

Performed by:

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1. Subject matter of the work

The subject matter of this test report is the determination of the air purification performance of materials that contain a photocatalyst or have a photocatalytic film on the surface. The sample to be tested was continually exposed to the airborne pollutant nitric oxide (NO) while being illuminated with ultraviolet light. The net amount of NO_x removed from the sample is therefore the way of measuring photocatalytic activity, whereby a subsequent elution test to recover surface adsorbates was not performed. The work was performed based on ISO 22197-1. In deviation from this the volume flow was reduced from 3 L/min to 1 L/min.

This method is suitable for photocatalytic materials which have been produced for air purification applications. This test is not suitable for calculating the other photocatalytic characteristics of photocatalytic materials, such as the water purification performance, self-cleaning, anti-fogging or anti-bacterial characteristics. This method solely concerns the removal of nitric oxide.

2. Overview of the tested samples

For the performance of the tests, IST was provided with a homogenously coated felt sample with the following dimensions: 49.5±0.5 x 99.5±0.5 mm. The samples submitted by the client for testing were previously blown with nitrogen and pre-activated with UV illumination.

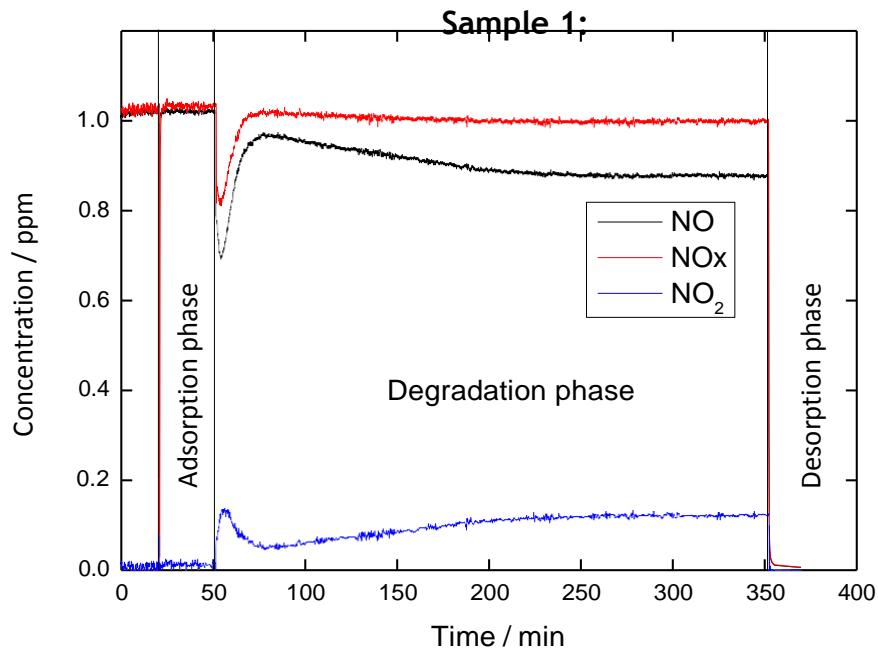
No.	Sample name
Sample 1	HT coating

3. Overview of the test conditions

Test procedure	Based on ISO 22197-1:2007 Test method for air-purification performance of semiconducting photocatalytic materials Part 1: Removal of nitric oxide
Test laboratory	Fraunhofer Institute for Surface engineering and thin films IST Bienroder Weg 54 E 38108 Braunschweig
Test period	31/10/2013 - 01/11/2013
Tester	Tobias Graumann (graduate chemist)
Description of the sample	White tile with the dimensions: 49.5 x 99.5 mm
Pre-treatment of sample	Blown with nitrogen, UV pre-conditioning
Laboratory conditions	21±2°C, 49±7% RH
Test conditions	1 ppmv of nitric oxide in the test air (KW-free) at 1 L/min Temperature in the reactor: 21±1°C Air humidity in the reactor: 50±2% RH
Analyzer	Environment S.A., AC32M Chemiluminescence detector, no auxiliary gases, selective NO measurement, pre-reaction chamber for cyclical zero adjustment
UV lamp (pre-conditioning)	Philips Actinic fluorescent lamp BL TL-K 40W; 2,3 mW/cm ² ; Sample 1: exposure for 1 day, continual
UV lamp (test)	FSLED365.10_10, LED based surface radiator, 10 x 10cm, Omicron-Laserage Laserprodukte GmbH, 365 nm, 1.00 mW/cm ²
UV test device	Ophir 3A-P-FS thermopile (Nova II), calibrated in September 2013 (Ophir Spiricon Europe GmbH)
Deviations from the standard	Reduction in the volume flow from 3 L/min to 1 L/min, no elution test (paragraph 8.3 ISO 22197-1:2007)

Specific test results

Graphic presentation of the test results:



Tabular representation of the test results as per ISO 31-0, unit: μmol

No.	NO _x adsorbed	NO removed	NO ₂ generated	NO _x desorbed	NO _x removed
Sample 1	0.0	1.7	1.3	0.0	0.4

4. Summary of the test results

The photocatalytic air cleaning performance of the evaluated test specimens has been determined based on the net quantity of the removed nitric oxide (NO_x). This has been calculated using the following formula:

$$n_{NO_x} = n_{ads} + n_{NO} - n_{NO_2} - n_{des}$$

- whereby: n_{NO_x} = NO_x removed from the test specimen (μmol),
- n_{ads} = NO_x adsorbed from the test specimen (μmol),
- n_{NO} = NO removed from the test specimen (μmol),
- n_{NO_2} = NO₂ generated from the test specimen (μmol),
- n_{des} = NO_x desorbed from the test specimen (μmol),

The net quantity of NO_x removed, for the sample

HT coating

was 0.4 μmol and with the defined test parameters exhibited a photocatalytic air purification effect for the removal of nitric oxide.

Braunschweig, November 2013