

1 Diagram illustrating the effect of photocatalytic coatings, left: pollutant degradation, right: self-cleaning effect.

## PHOTOCATALYSIS TEST METHOD FOR EVALUATING PHOTOCATALYTIC COATINGS

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#### Photocatalytic coatings

Photocatalytic coatings are used to functionalize surfaces. For example, they can be implemented as paints for facades to purify the air and/or self-clean surfaces. The photocatalysts contained in the coating are activated by UV light, thus triggering the degradation reaction of pollutants or contaminants.

#### Test methods at Fraunhofer IPA

For the investigation of the functionality of photocatalytic coatings, special test setups are required. Each test method calls for different measuring equipment.

At Fraunhofer IPA, we have a range of measuring equipment for testing the photocatalytic activity of coatings and other materials:

- DIN ISO 22197- 1: Removal of nitric oxide (NO degradation)
- DIN 52980: Determination of photocatalytic activity of surfaces in an aqueous medium by degradation of methylene blue
- VOC degradation in the FPL reactor

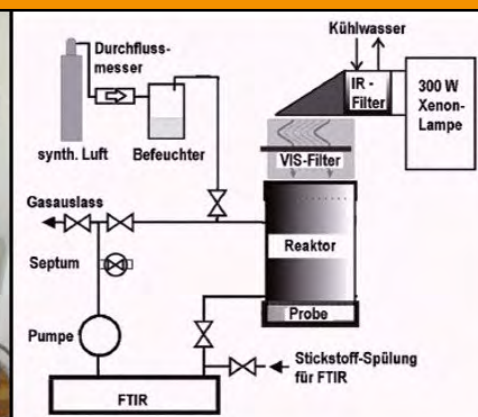
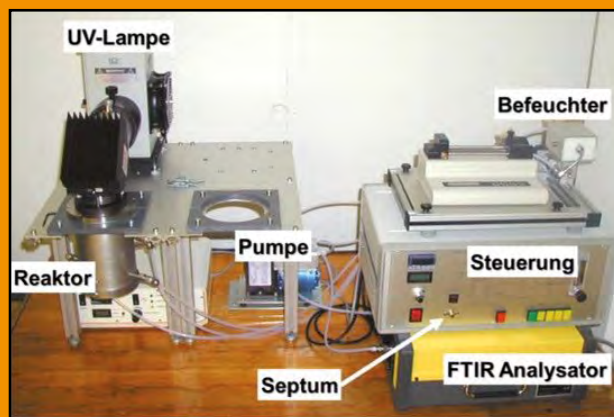
#### Standardized test procedures

The determination of methylene blue degradation (DIN 52980) is used to evaluate the decrease in color intensity of a methylene blue solution in the presence of the photocatalytic coating under UV light compared to the dark value.

In the case of nitric oxide degradation, the decrease in the NO concentration in the gas mixture is detected in a flow-type photoreactor. To this end, the NO concentration is



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measured in several phases (unexposed and exposed to UV light) in order to evaluate the activity of the samples.

From the values obtained, the efficiency of the degradation process can be investigated.

Therefore, quantities such as photon efficiency or degradation rate can be determined with both tests. The same test set-up can be used to rank different products.

#### Pollutant degradation in the FPL reactor

When assessing VOC degradation in the FPL reactor, the intrinsic degradation of the coatings is investigated in addition to the photocatalytic activity during the degradation of various model pollutants. This allows conclusions to be drawn about the long-term stability of the coating.

Online detection of the model pollutants and their degradation products by gas-phase IR also provides information about the kinetics of the degradation reaction.

The use of different model pollutants gives information about adsorption behavior and surface polarity. Furthermore, this method can be implemented to determine the efficiency of the tested materials and to rank different samples.

#### Model formulations

One of Fraunhofer IPA's skills lies in developing model formulations for various applications. In a large number of projects, formulations for photocatalytic coatings have already been developed and produced for diverse applications and their properties tested. This has resulted in comprehensive expertise on the incorporation of nanoparticulate photocatalysts into different types of binders. This know-how can be used to assist customers with similar concerns.

Besides analyzing photocatalytic activity, further important properties of coatings can also be extensively studied. In addition to mechanical and application properties, structural analysis can also be performed using techniques such as microscopy or SEM.

#### Project examples

Photocatalytic coatings have already been developed, produced and studied in a number of research projects at Fraunhofer IPA.

In the AiF research project "Clean Facades", photocatalytic coatings with self-cleaning properties were developed. In the "PhotoKal" research project funded by the German Federal Ministry of Economic Affairs and Energy, inorganic-based coatings could be produced that exhibit exceptional photocatalytic activity due to a high nano titanium dioxide content in the coating.

2 Flow reactor for nitric oxide degradation.

3 Test setup for VOC degradation in the FPL reactor.

#### CUSTOMER BENEFITS

- Standardized tests conducted to investigate and rank the photocatalytic activity of materials
- Implementation of methods for degrading various organic pollutants (VOC) from photocatalytic materials
- Tests on self-cleaning effects of photocatalytic coatings
- Tests on the resistance of coatings to UV light (intrinsic degradation during the photocatalytic reaction)
- Assistance with the development of model formulations for photocatalytic coatings
- Tests to evaluate the properties of photocatalytic coatings
- Use of a wide range of testing options to ensure the required product quality